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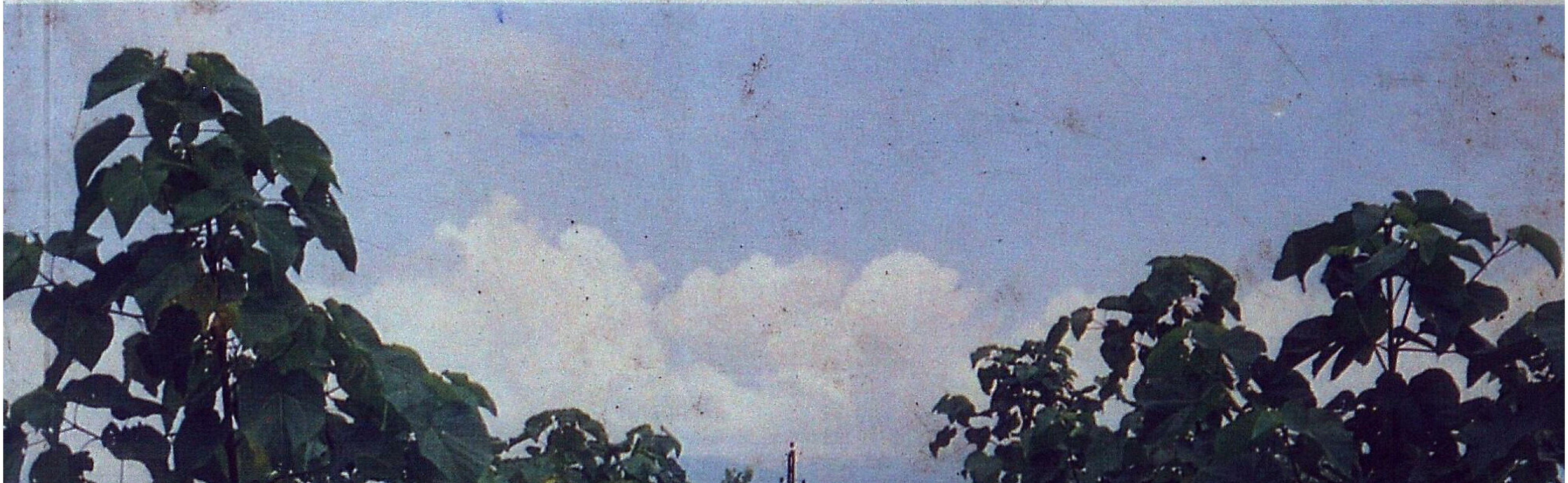

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FRONT COVER

PAULOWNIA FORTUNEI BASED AGRO-FORESTRY SYSTEM IN FARMERS' FIELD AT SELAKUI VILLAGE, DOON VALLEY (UTTARANCHAL).

Photo - Charan Singh

CONTENTS

ARTICLES

WATERSHED MANAGEMENT IN RAINFED AREAS : LEARNING FROM THE PEOPLE.
D.D. Sharma and Anita Sharma............................ 845

LOCAL DEMANDS OF FOREST PRODUCE AND WORKING PLAN (A CASE STUDY OF VYARA FOREST DIVISION IN GUJARAT).
A.K. Verma.. 855

STUDIES ON SEXUAL VARIATION IN CLONES OF *CASUARINA EQUISETIFOLIA* FORST.
Kannan Chandra Shekhara Warrier, K.G. Ajith Kumar, Rekha R. Warrier and K. Gurumurthi.. 865

ON UPPER BIAS IN 'FOREST COVER' DATA OF HILLY TERRAIN OBTAINED THROUGH SATELLITE IMAGERY WITH SPECIAL REFERENCE TO MIZORAM.
Sanjeeva Kumar Jha.. 871

UNCARIA GAMBIER - A NEW SOURCE OF KATHA.
P.L. Soni and H.W. Sharma...................................... 879

FOREST SOIL : VEGETATION RELATIONSHIP IN MUSSOORIE FOREST DIVISION (UTTARANCHAL)
A.K. Raina, M.N. Jha and S.C. Pharasi..................... 883

FIRST RECORD OF COCCINELLID BEETLES (COLEOPTERA : COCCINELLIDAE) ON POPLAR, *POPULUS DELTOIDES* FROM NORTH INDIA.
Mukhtar Ahmad, Md. Jamal Ahmad, Shama Afroze and R.K. Mishra... 891

NEEM OIL EXTRACTION AND USES.
P.P. Jain, Ravindra Singh and Shalini Bhadula.......... 898

GROWTH RESPONSE OF *DALBERGIA SISSOO* TO AM AND *RHIZOBIUM* INOCULATIONS AND FERTILIZATION IN NURSERY.
S.N. Khan, Kamla Uniyal and Rajiv Pandey............... 906

HOSTS AND THE PATHOGEN-SPECIES COMBINATIONS OF THE GENUS *PYTHIUM* IN INDIA.
V.K. Tiwari and J.K. Misra....................................... 910

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STANDARDIZATION OF PROPER VOLUME/SIZE AND TYPE OF ROOT TRAINER FOR RAISING *ACACIA NILOTICA* SEEDLINGS : NURSERY EVALUATION AND FIELD TRIAL.
H.S. Ginwal, P.S. Rawat, Sandeep Sharma, A.S. Bhandari, C. Krishnan and P.K. Shukla 920

TRADITIONAL INITIATIVES IN PARTICIPATORY FOREST MANAGEMENT : DODRA-KWAR (SHIMLA - H.P.) EXPERIENCE.
R.C. Dhiman 929

IMPACT OF VAM INOCULATION ON SOME SEMI-ARID TREE SPECIES.
K.K. Srivastava, V. Mohan and Neelam Verma 936

RESEARCH NOTES

I. OCCURRENCE OF MONO- AND POLY-EMBRYONIC ALBINO SEEDLINGS IN *MADHUCA BOURDILLONII* (GAMBLE) RAIZADA.
S. Abdul Kader and K.C. Chacko 941

II. EFFECT OF GIBBERELLIC ACID (GA_3) ON GERMINATION OF *GIVOTIA ROTTLERIFORMIS* GRIFF., SEEDS.
D.J.S. Kiran, P.S. Rao, K. Venkaiah and A. Saibabu... 944

III. A NEW RECORD OF ROOT BORER ON *ALBIZIA LEBBEK* IN TAMIL NADU.
A. Balu, K.R. Sasidharan and R. Rajarishi 947

IV. *CYATHUS* AND *GEASTRUM* - AN ADDITION TO DARJEELING MYCOFLORA.
Krishnendu Acharya and Rupa Acharya 950

V. INTRODUCTION OF *PAULOWNIA FORTUNEI* IN AGROFORESTRY FARMING SYSTEMS UNDER RAINFED CONDITIONS AT DOON VALLEY, INDIA.
Charan Singh 953

FOREST NOTES AND OBSERVATIONS 956

FROM THE INDIAN FORESTER - ONE HUNDRED YEARS AGO 958

LETTER TO THE EDITOR 959

REVIEW 960

GAZETTE NOTIFICATIONS 961

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WATERSHED MANAGEMENT IN RAINFED AREAS : LEARNING FROM THE PEOPLE

D.D. SHARMA* AND ANITA SHARMA**

Introduction

Rainfed areas are not served with assured means of irrigation. Under tropical and sub-tropical climate, where rainfall is limited only to 3 to 4 months, even high rainfall areas suffer from moisture scarcity during long dry months of winter and summer.

Out of an estimated 12 million ha of cultivated areas of our country, about 50 million ha is presently irrigated, leaving a vast 92 million ha under rainfed system. Rainfed areas play an important role in agricultural economy of our country contributing about 42% of total food grain production, 80% oilseeds, 65% cotton and bulk of pulses.

Due to growing pressure of human and livestock population, most of the rainfed areas are under varying degrees of degradation. Such vast rainfed tract holds the key to the ecological health of the country.

Watershed-development for rainfed areas is an integrated area development approach to promote mixed farming systems under complex, diverse and risk prone environment. It is aimed at sustainable production of biomass of food, fodder, fuel, timber and fibre, etc. through scientific utilization of land, water, plant and animal resources in a watershed with twin objectives of restoration of ecological balance and socio-economic welfare of watershed community.

Rainfed areas contribute 9% of the total National GDP, 36% of agricultural export and 10% of total export from the country. By and large, hides, skins, meat, meat products, medicinal and aromatic plants and large varieties of tropical fruits grown in rainfed conditions have both a domestic and export market.

This paper describes the watershed area development approach being pursued in rainfed areas which has evolved on the basis of accumulated wisdom and skill of the local watershed community and the lessons learnt in the field from the experience gained during past 70 years.

Definition of Watershed

The term watershed is derived from a German word "Wasser Schide" used to describe a mass of land that drains at a

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common point. This geo-hydrological unit is evolved through the interaction of rain water with land mass and typically comprises of arable land, non-arable land and natural drainage lines. In due course of time, however, the term has evolved to cover even those areas where distinguishable drainage lines do not exist.

Evolution of Watershed Management Programme in India

In pursuance of recommendation of Royal Commission on Agriculture related with Dryland Farming, four research stations were established in early 1920s at Hagari, Raichur, Rohtak and Sholapur, As a result of research carried out at these stations, field bunding, deep ploughing, fallowing of land, cropping in alternate years, use of bulky organic manure and moisture conservation measures were followed in 1930s. Only arable lands were covered under this approach which received a limited success.

During the 1950s, research efforts were directed towards soil and moisture conservation to stabilize the catchment areas of multi-purpose dams to prevent the siltation of reservoir. A number of research stations and training centers of Central Soil and Water Conservation Research and Training Institute (CSWCRTI), Dehra Dun were started at various places in the country. The production system was, however, relegated to the background.

The national goal of self sufficiency in the matter of food grains was achieved mainly through the intensive efforts initiated in the irrigated areas in 1960s. It was, however, realized that attention should be paid to rainfed agriculture also for equity and even distribution of gains of development to minimise fluctuation from year to year production of food grains as well as for stepping up the availability of fuelwood and fodder. In the year 1972-73, All India Coordinated Research Project on Dryland Agriculture was launched at 24 locations in different agro-climatic regions of the country. Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad looked after this project. In the vicinity of each research station, a pilot project for Integrated Dryland Agricultural Development was taken up to test, restore and adapt the technology generated by these stations. A number of findings from these efforts included raising of good potential crop varieties, moisture conservation measures and input oriented cropping system. This project, however, could not be adopted in a big way because of uncertainty in rainfall and the resource-poor conditions of the farmers in the dryland areas.

In the 1970s, the CSWCRTI initiated watershed management projects at Sukhomajri (Chandigarh), Fakot (Garhwal Himalayas) and at G.R. Halli (Chitradurga), Karanataka. This was followed by the ICAR model watersheds developed by the CSWCRTI, Dehra Dun and CRIDA, Hyderabad.

By the end of the 1970s, it became clear that the future of rainfed areas will continue to fluctuate unless the rainwater is conserved and utilized scientifically. Keeping this in view, in the early 1980s i.e. during the period of Sixth Plan, a Pilot Project for Propagation of Water Conservation/Harvesting Technology for Rainfed Areas on Watershed Basis was launched by the Department of Agriculture and Cooperation of the Central

Government in 19 watersheds located in the rainfed areas. The Department of Rural Development also launched this project in 23 watersheds selected in the areas implementing Drought Prone Area Programme. These projects generated wealth of information and it was realized that there is a need for bringing vegetative conservation measures and promoting a simple and affordable conservation/ harvesting technology. This experience went into launching of the National Watershed Development Programme for Rainfed Agriculture in the Seventh Plan covering 99 districts in 16 States. This programme was related only with the treatment of arable lands and consisted mostly of crop production components. By a queer logic, rainfed areas of the country receiving less than 750 mm annual rainfall were excluded from this programme thereby depriving poorest of the poor residing in the vast tracts of rainfed areas of the country from the benefits of this programme (Anon., 1992).

During more than 70 years of research activities, valuable lessons were learnt in the field of watershed management in the rainfed areas. The check dams or silt detention dams designed as micro-irrigation dams to hold water and force it to discharge its silt load were very costly to put in place and required annual repair and maintenance. Occasionally, even adjoining fields were submerged. It was, therefore, realized that the conventional engineering structures centred soil conservation technology conceived and designed for temperate climate where rainfall is spread over longer period and suitable for large sized farms was inappropriate under tropical and sub-tropical climate of our country where rainfall is limited to 3 to 4 months and with small size holdings of resource poor farmers.

Tropical Climate Tuned Indigenous Technology

Water is the most critical factor for all kinds of living beings and biomass production in the rainfed areas particularly in the tropical and sub-tropical climate. The rainfall in these areas is characterized by the following :

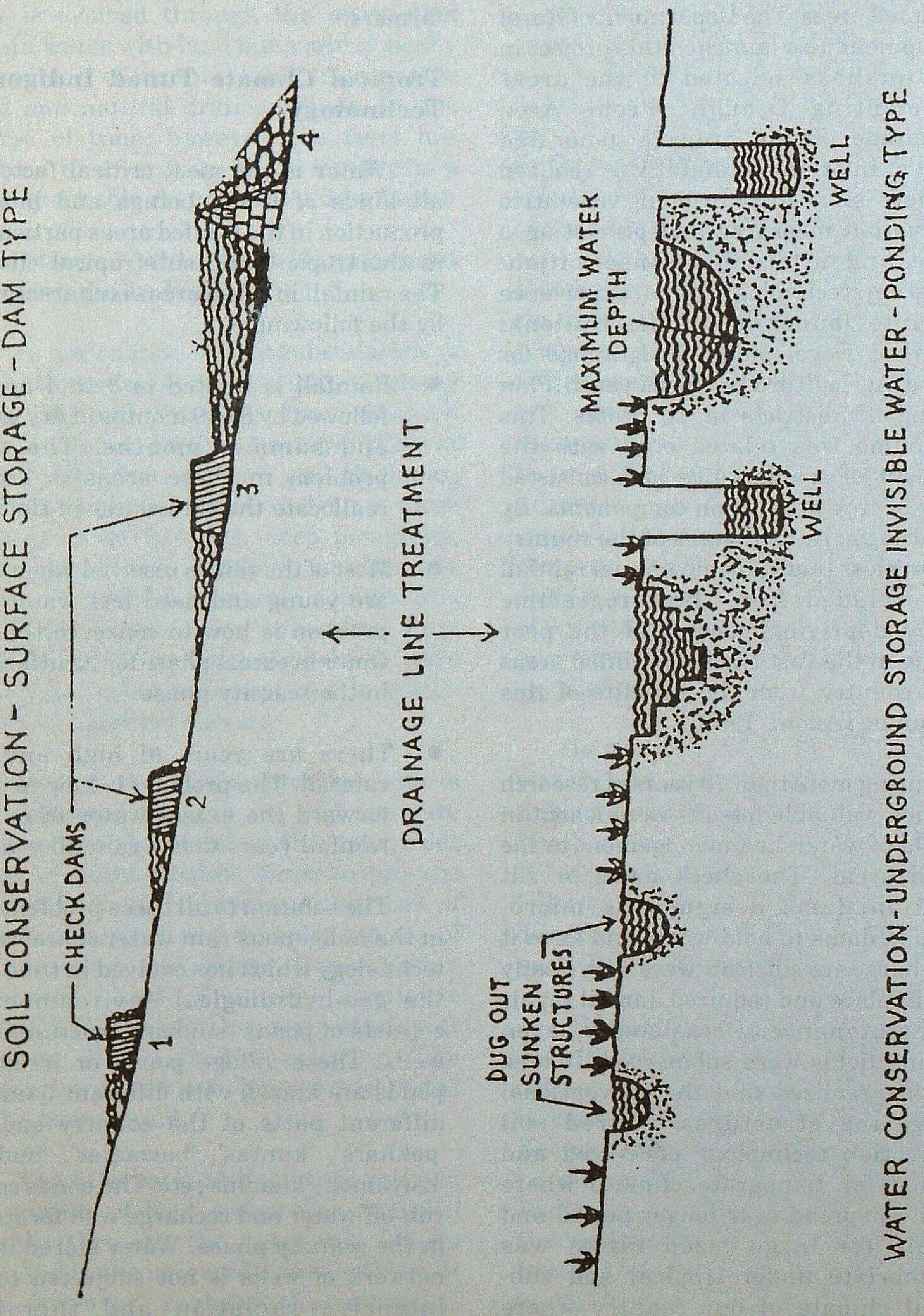
- Rainfall is limited to 3 to 4 months followed by 8 to 9 months of dry winter and summer months. The main problem in these areas is how to reallocate the rain water in time.

- Most of the rain is received when crops are young and need less water. The problem is how to conserve the rain water in excess phase for its utilization in the scarcity phase.

- There are years of high and low rainfall. The problem is how to carry forward the excess water from high rainfall years to low rainfall years.

The solution to all these problems lies in the indigenous rain water conservation technology which has evolved in tune with the geo-hydrological environment. It consists of ponds (sunken structures) and wells. These village ponds or irrigation ponds are known with different names in different parts of the country such as 'pokhars', 'kuntas', 'bawadies', 'oudees', 'kalyanies', 'khadins', etc. The ponds collect run-off water and recharge well for its use in the scarcity phase. Water stored in the network of wells is not subjected to the intensive radiation and therefore, evaporation losses are reduced. This

Fig. 1


SOIL CONSERVATION - SURFACE STORAGE - DAM TYPE
CHECK DAMS
1
2
3
4
DRAINAGE LINE TREATMENT
DUG OUT SUNKEN STRUCTURES
MAXIMUM WATER DEPTH
WELL
WELL
WATER CONSERVATION-UNDERGROUND STORAGE INVISIBLE WATER-PONDING TYPE

Rainwater run-off management for Tropical/Sub-tropical rainfeed regions combination of ponds and wells reallocates water in time. Here, the surface flow (run off) is converted into sub-surface flow (deep percolation) and the velocity and quantity of water going outside the watershed is also reduced. Thus, instead of holding the water above the surface, the indigenous technology is based on the principle of holding the water below the surface. This technology conserves both water and soil. Rain water is also stored in underground open or closed tanks, on a small scale by individuals or on a large scale by the village community. In fact, we have forgotten this rain water conservation technology which used to be the key to prosperity of our country (Seth, 1993; Anon., 1993b; Anon., 1994a, b). The significance of this approach has been highlighted in *The Upanishad*, a timeless scripture of our country which reads as under :

"आकाशात् पतितं तोयं ।
यथा संरक्षयत्ति भूमि परं ।।
तथैव सर्वत्र कृषि मित्कृषस्व ।
इदमेव जीवनं श्रेयसं बहुजन्य मान्या: ।।"

In brief, it means if the water received from the sky is conserved on and below the earth, it is enough to meet the requirements of all plants and animals.

If we look at nature's system from promotion of *in- situ* moisture conservation and control of soil erosion, combination of herbs, shrubs and trees play an important role. The herbs check soil erosion by both flowing and falling water during rainy season. They resist splash, sheet and gully erosion and store enormous quantity of rain water. The shrubs intercept falling rain water to some extent and store good quantity of rain water which is available during post rainy season, thus reallocate water in time. The water is mainly intercepted by the trees though their role in controlling sheet, rill and gully erosion is limited. The trees store large quantity of water and thus reallocate water in time. From the forgoing account, it is clear that ground cover is necessary in the watershed areas. The trees should not be planted so close that nothing grows beneath. There must be dense cover of grasses and forage species on the ground itself. In the long run, the leaf and twig litter beneath the trees contribute towards water absorption, its percolation into the soil and retention so as to increase the water level and reduce tendency towards flooding. It also releases water slowly over a long period, increasing the flow from springs and streams in dry season. In the watershed area, suitable combination of herbs, shrubs and trees should be used which may act as nature's system for control of erosion, promotion of *in-situ* moisture conservation and storage of water (Sharma, 1993 b).

Most of the herbs complete their life cycle by September-October. Shrubs are green even after rainy season and provide biomass particularly fodder during winter period i.e. November to February whereas the trees provide green biomass during summer season when grasses are dry and unproductive. Combination of herbs, shrubs and trees is, therefore, also necessary for continuous availability of biomass in the rainfed areas to meet the requirement of human and animal population in the following manner :

- Grasses for sheep which graze;
- Shrubs for goats which browse; and

- Trees as sources of fodder for stall-fed animals as well as fuel, fruit, etc for humans (Anon., 1992)

Adoption of Integrated Watershed Area Development Approach

Based on the experience gained in watershed management in rainfed areas during past 70 years, it is realized that the rainfed areas can not be developed unless rainwater received during excess phase is conserved *in-situ* for its utilization in scarcity phase. Thus detaining, retaining and using every drop of rainwater as it falls and where it falls should be the first maxim of watershed management in rainfed areas (Sharma, 1993 a). All the three components of land mass viz. arable land, non-arable land and drainage line should be planned and developed as one organic unit. In the early stages of watershed development, a sectoral approach was adopted in which agriculture, forestry, horticulture and livestock development, etc were planned and implemented independently. This approach brought about unintended distortions. It is, therefore, felt necessary that an integrated approach should be adopted comprising all the components like agriculture, forestry, horticulture, livestock development and household production systems, etc.

Another major shortcoming of watershed development approach has been the lack of people's participation. It is now recognized that the vast rainfed areas can not be developed without people's participation. The technology should be built on accumulated wisdom and skill of local watershed community. Existing farmers' practices should be analysed and integrated intensive farming practices being adopted by the farmers who obtain high yields through mixed farming, multiple cropping by following ecologically sound practices should be compiled and extended to a wider group instead of promoting new practices from elsewhere. If at all some amendments/improvements are required, these should be made in such a way so that these are acceptable and easily understood by the farmers. This enables people's participation right from the very beginning i.e. from planning and implementation stage to monitoring and evaluation stage. It also makes the post management very easy. Diversified farming practices including annual crops (mixed cropping, inter cropping and double cropping) duly fortified with agroforestry and rainfed horticulture should be promoted in the rainfed areas. Livestock which play a dominant role in degeneration and regeneration of ecosystem should also be given due attention.

On the basis of lessons learnt as outlined above and based on full understanding that the conservation measures are the 'means' and production systems are the 'ends', an integrated watershed project i.e. National Watershed Development Project for Rainfed Areas (NWDPRA) was taken up during Eighth Plan to develop micro-watersheds of area ranging between 500-1000 ha as models of comprehensive integrated development in different agro-climatic regions of the country. This project is aimed at conserving the rain water *in-situ* mainly through traditional pond type sunken structures on drainage lines in the upper reaches, in the vicinity of drainage lines in the middle and lower reaches and eco-friendly agricultural production systems on arable land as well as three tier appropriate vegetation consisting of grasses, shrubs and trees of fodder, fuel, timber and fruit varieties on non-arable lands in topo sequence in consonance with soil depth and moisture (Anon., 1992).

The details of the project content are as follows :

(1) *Arable lands*

Conservation measures :

- Vegetative hedges with ridges and furrows to filter run-off water and control soil erosion with more reliance on vegetative measures;
- Repair of existing conservation structures;
- Contour cultivation for *in-situ* moisture conservation;
- Measures for gully control;
- Organic farming including Integrated Nutrients Management and Integrated Pest Management. Promotion of bio-fertilisers and bulky organic manure to promote moisture holding capacity of soil;
- Cultural, mechanical, biological control of pests in such a way so as to keep the pests and weed management below the economic injury level and help minimize the pollution due to chemicals.

Production systems :

- Diversified production systems including mixed cropping, inter cropping, alley cropping duly fortified with agroforestry and dryland horticulture in a mosaic pattern in tune with soil and moisture regime and not as block plantation; crop demonstrations.

(2) *Non-arable lands*

Conservation measures :

- Contour vegetative hedges/contour furrows to conserve moisture.

Production systems :

- Overseeding of grasses and legumes for forage and pasture development;
- Planting of shrubs for fodder and fuel; and
- Planting of trees in silvi-pastoral systems.

(3) *Treatment of drainage lines*

- Clearance of drainage congestion by deepening water bodies and creating a network of ponds;
- Stabilisation of nala banks primarily with vegetative measures; and
- Construction of dug-out structures and series of small run-off management structures: Vegetative checks, brush wood checks, loose boulder checks on or along the drainage lines in the upper and middle reaches, bank stabilization and bigger dug-outs in the natural depressions connecting the village ponds with drainage lines to recharge the wells near dug outs.

(4) ***Livestock management***

- Livestock population control through castration of scrub bulls and other means;
- Production of fodder on cultivated lands; and
- Promotion of natural breeding.

(5) ***Household Production System***

- To supplement food, income and nutrition through rearing of small livestock; biomass/agro-processing including basket making, rope making, mat making, leaf plate making, various handicrafts, cottage scale food processing; and service sector including carpentry, blacksmithy, etc.

These components are being implemented through multi-disciplinary watershed development team having expertise in all the sectors such as Agriculture, Forestry, Horticulture, Animal Husbandry, etc (Anon., 1992; Anon., 1993 a, b).

A system has also been evolved wherein the best elements of government functioning as well as NGO functioning are combined effectively to bring about the best possible results which are otherwise not possible when either of them is the implementing agency. The institutions involved to implement this project are the Government, NGO and watershed community represented by the Mitra Krishak Mandal. Mitra Krishak Mandal consists of a group of Mitra Kisans, five from each village of the concerned micro-watershed. Out of five Mitra Kisans, two are women farmers, two are landless agricultural labourers, one of whom is trained as Gopal to take care of livestock component and other represent the artisans, and one enlightened farmer open to innovative ideas. The roles and responsibilities of these institutions are well defined. The local community is being involved right from the project preparation stage to implementation, monitoring and evaluation stage (Sharma, 1993b; Anon., 1995). Affordability, replicability and sustainability are main planks of this project.

Impact evaluation studies of NWDPRA conducted by five Agro-economic Research Centres have revealed improvement in crop yield, fodder production and recharge of ground water table which is expected to have positive impact on the living standard of rural people. The NWDPRA is being continued during Ninth Five Year Plan to cover more and more rainfed areas (Anon., 1996).

Conclusion

Integrated Watershed Area Development Approach is being pursued in the rainfed areas where availability of water is dependent on erratic amount and distribution of rainfall. *In-situ* moisture conservation and diversified and mixed farming systems are being practiced in these areas which include agriculture, forestry, horticulture, animal husbandry, etc. This approach is mainly based on the accumulated wisdom and skill of watershed community.

Acknowledgements

The first author gratefully acknowledges some of the local watershed communities in the States of Rajasthan and Uttar Pradesh for sharing their valuable experience in the field of watershed management in rainfed areas.

SUMMARY

All the spatial components of land mass viz. arable land, non-arable land and drainage lines are being developed as one organic unit under the project "National Watershed Development Project for Rainfed Areas" which is mainly based on people's indigenous knowledge. Recognising that it is not possible to motivate most of the rural people without economic incentive, the technology comprises of both, the conservation systems and production systems.

बारानी क्षेत्रों में जलागम प्रबन्ध : लोगों से ज्ञानार्जन

डी॰डी॰ शर्मा व अनिता शर्मा

सारांश

बारानी क्षेत्रों की राष्ट्रीय जलागम विकास परियोजना जो कि प्रमुखत: स्थानीय लोगों के अनुभव पर आधारित है, के अन्तर्गत भूमि के तीनों घटकों - कृषि भूमि, गैर-कृषि भूमि एंव विकास नालियों का उपचार किया जा रहा है । यह मानते हुए कि बिना आर्थिक लाभ के स्थानीय लोगों को प्रेरित नहीं किया जा सकता है, इस परियोजना में संरक्षण प्रणाली के साथ-साथ उत्पादन प्रणाली का भी समावेश किया गया है ।

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LOCAL DEMANDS OF FOREST PRODUCE AND WORKING PLAN (A CASE STUDY OF VYARA FOREST DIVISION IN GUJARAT)

A.K. VERMA*

Introduction

National Forest Policy (NFP) 1988 recognises the dependence of tribals and other poor living within and near forests, on the local forest resource and prescribes that their domestic requirements of fuelwood, fodder, minor forest produce and construction timber should be the first charge on forest produce. The principle aim of the National Forest Policy is environment conservation and ecological balance, which are vital for sustenance of all life forms - man, animal and plants. Obviously, these two dictates of NFP convey that the forest conservation and the satisfaction of local needs of forest produce should be the two most important objectives of any forest Working Plan. Working Plans are the instrument to affect changes in management practices. Hence, removable yield from the forests consistent with the conservation requirement should take into account the local needs first.

Traditionally the Working Plans refer about the people and their wants in the tract dealt with, however quantitative estimation of their needs for forest produce has not been made in most of the working plans. With increasing degradations of forests, the annual yields are bound to reduce and the local requirement of forest produce may be quite comparable with them. Not only the quantity of the products but even the nature and kinds of product required by local people would have great effect on the methods of management. If the firewood needs are very high and the timber requirement low, it seems imperative to go for a management design which provides more firewood. This would suggest a thorough reconsideration of policy of management, species composition and rotation, harvesting regimes and even cultural operations. This paper attempts to estimate the local requirements of forest-produce in Vyara Forest Division area and compares them with estimation of wood biomass production for determining the availability of sustained yield and developing suitable management prescriptions.

In the past, sustained yield has been estimated only on the basis of calculated annual increment to the growing stock without taking the unrecorded removal of timber and firewood into account. The guidelines for preparation of working plans published by Government of India in 1983 indicate for recommending 50% removal of silviculturally available yield as a safeguard against over exploitation due to unrecorded removals. However very few working plans are found to have calculation of yield in accordance with this prescription. Of late Government of India insists for quantitative estimation of forest produce needs of the area covered under proposed Working Plan and also examines the measures prescribed for adequate supply. In Gujarat, the Forest Privilege Code defines a village as forest-village if it contributes its land to forests. The residents of the forest villages have privilege of collecting firewood from dead and fallen twigs and branches for their *bona-fide* domestic use as well as for earning their livelihood also. They are also allowed to graze the open forest area without paying any fees. The Government has allowed the distribution of timber and bamboo at very concessional rate (timber at 20% of the scheduled prices if they are within 10 km radius from forest) for house construction and repairs. But lifting of material even at this cheap rate is very less by the genuine beneficiary. In fact the people living very near to forests are used to getting these materials free of cost from the forests. Even the legitimate removal of forest produce i.e. firewood and grazing go unrecorded and while calculating sustained yield they are left out. The result is over exploitation and therefore it is necessary to make a realistic estimation of hitherto unrecorded removals of forest produce. For the purpose a small and rapid survey to do a case study was conducted by the Microplanning Cell of Working Plans Division, Surat.

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Survey

Within the limits of available time and manpower it was decided to take only four villages so situated that they are important habitation centres on the boundaries of major portion of the forests in different directions. Table 1 gives the demographic details of the selected villages. Assessment of their dependence on forests was also made by recording of the frequency of the families going to forests for various products. Their housing and its periodicity of construction and repairing was also recorded. Table 2 gives the details. It explains that about 100% families interviewed have 'Kachcha' (hutments or built of mud and wood) houses and 96% of them repair their house within 1 to 5 years. The interval of construction of house was at the equal distribution of around of 33% for 5 to 10 years, 11 to 12 years and 13 to 15 years. The forest dependence of the surveyed families is given in Fig. 1.

The survey tried to quantify the various forest products that people gather from the forests. It is evident that majority of the families (77%) collect one head load (i.e. 20 kg of firewood) every 2 to 4 days (Fig. 2). Considering a family of 5 members

Fig. 1

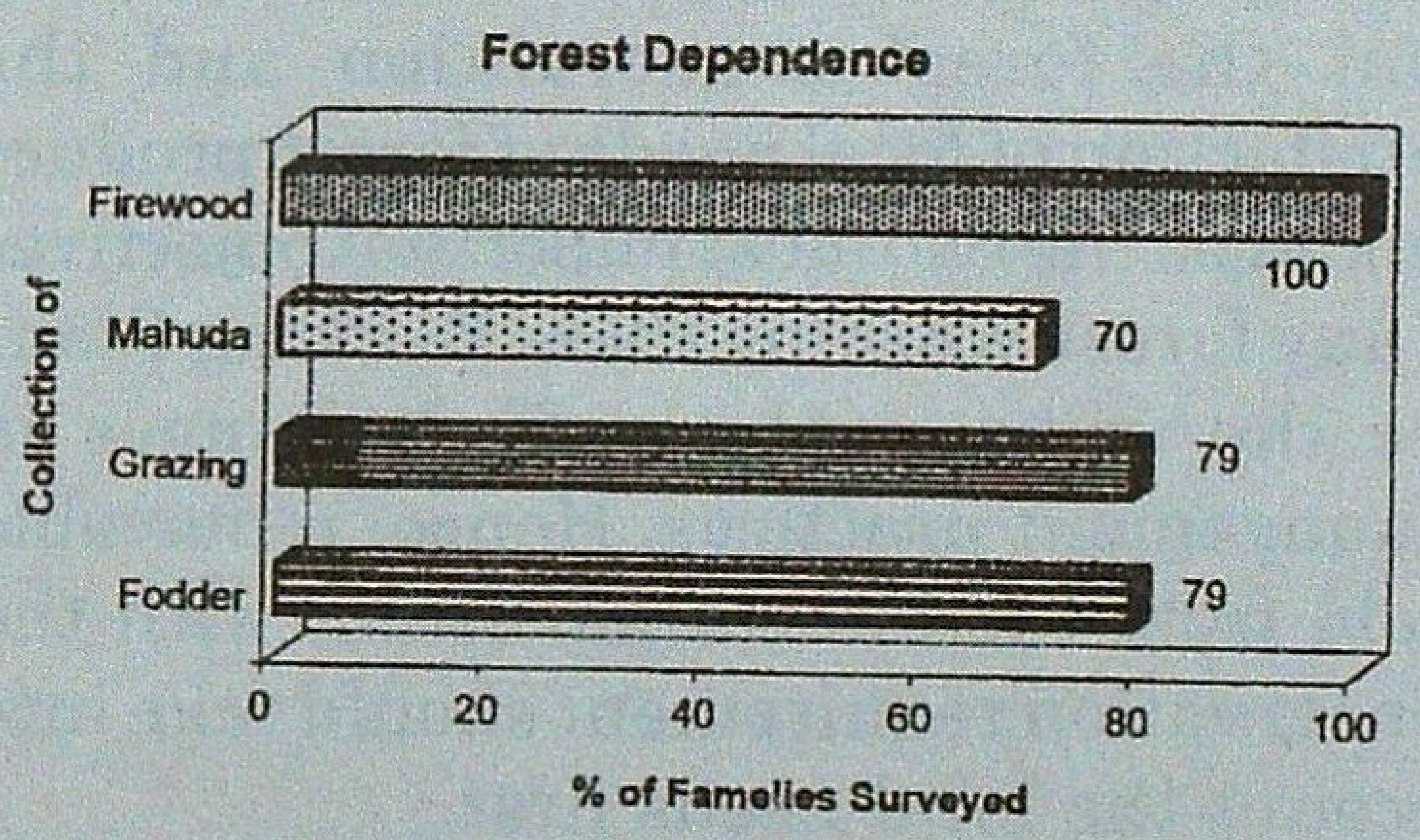

Forest Dependence

Fig. 2

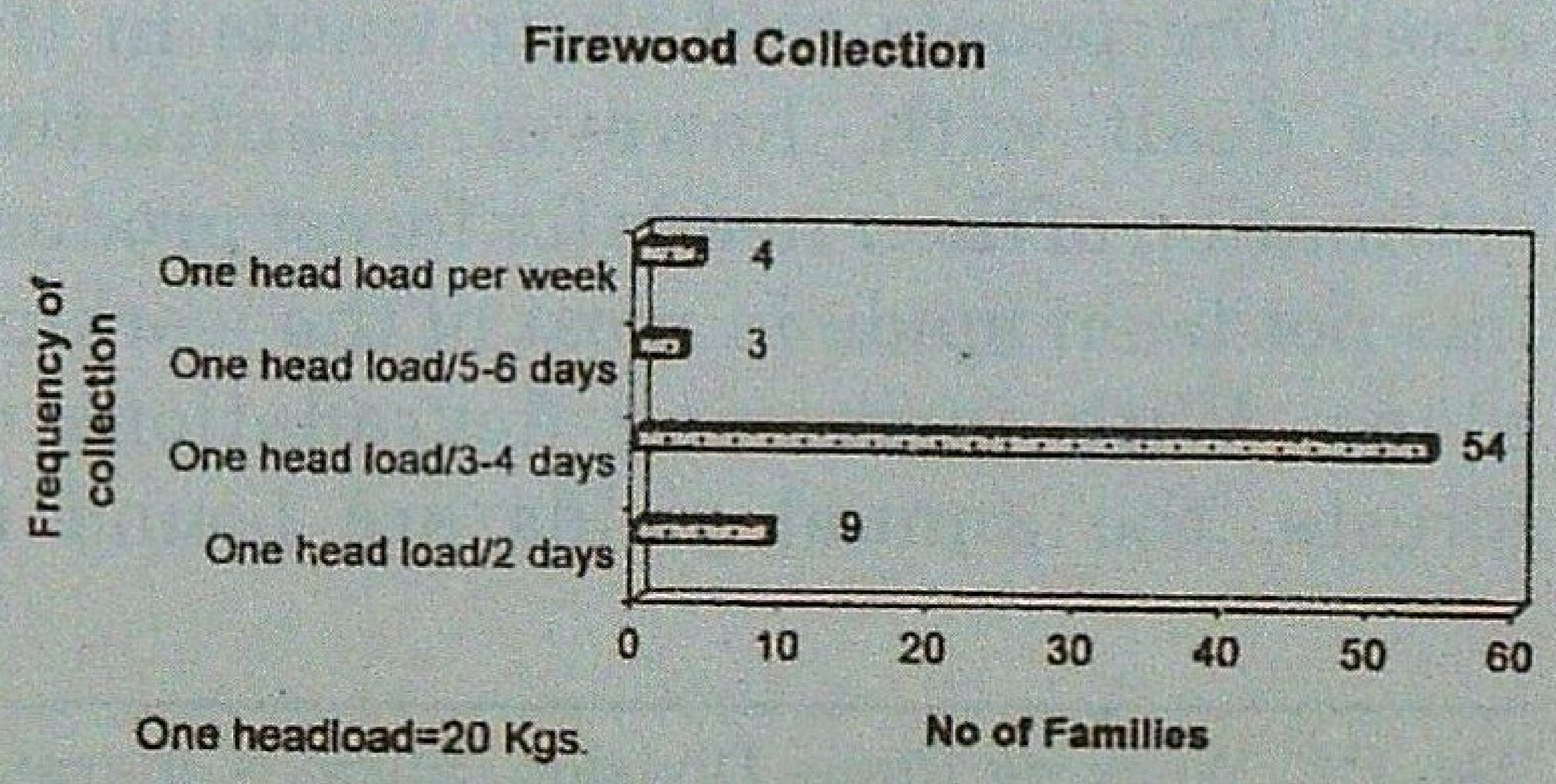

Firewood Collection

Table 1

Demographic details of selected villages

Village	Population	No. of households	No. of household surveyed	Category of family			Occupation				Family size (members)			Cattle holdings (nos)				
				ST	SC	Others	Farming	Agricultural labour	Labour	Other Occupation	Less than 5	5 to 10	More than 10	Without cattle	2	2 to 5	5 to 10	More than 10
Agashwan	1617	333	20	20	-	-	15	3	2	-	10	10	-	4	4	8	4	-
Kherwada	1569	288	17	17	-	-	11	2	4	-	5	11	1	2	2	6	4	3
Malangdev	1116	234	18	18	-	-	6	10	2	-	4	14	-	4	3	4	4	3
Tavali	287	-	15	15	-	-	2	12	1	-	5	8	2	4	2	5	3	1

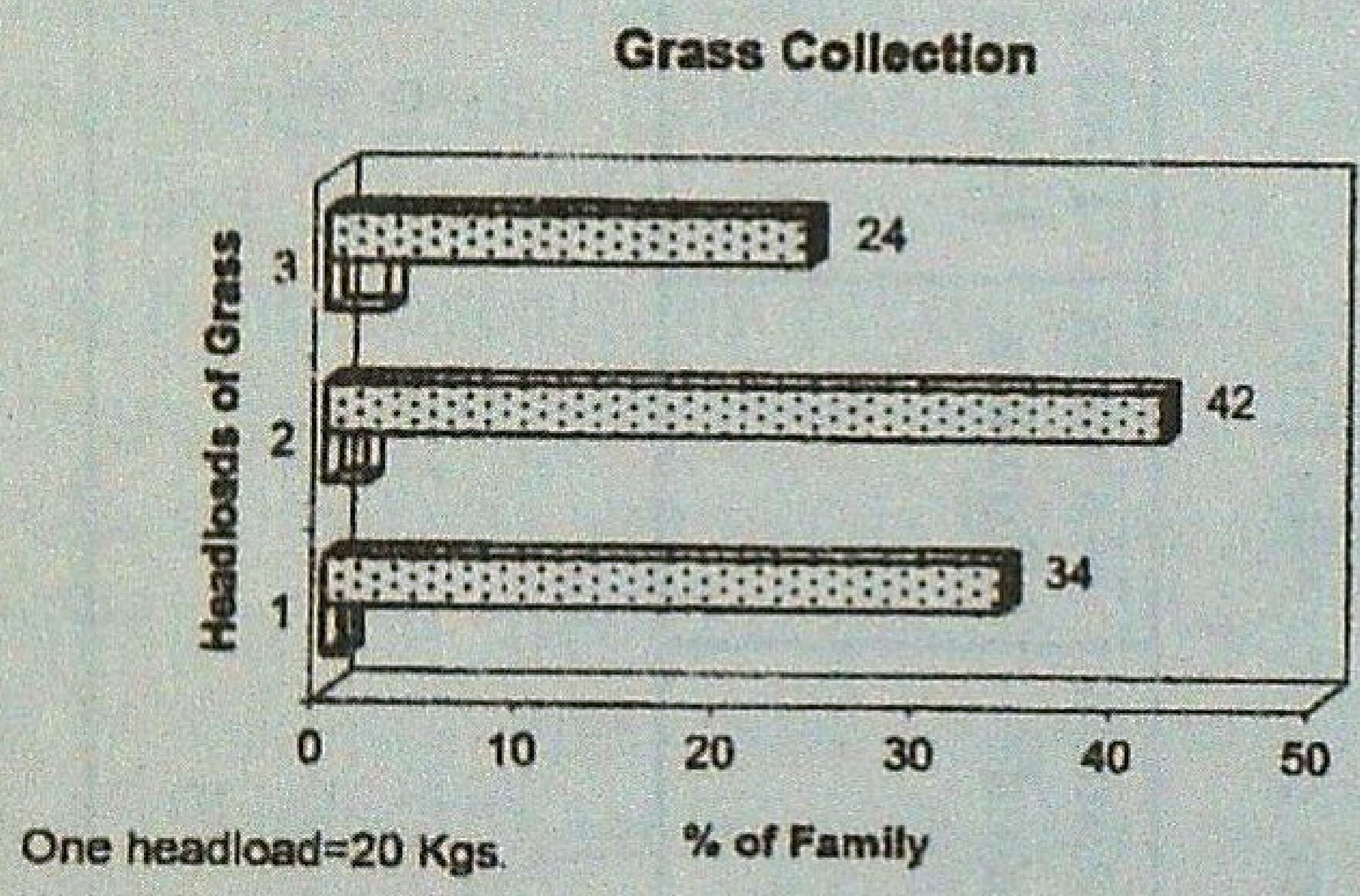
Table 2

Dependence on forests

Village	Type of house		Dependence on forests for							Interval for house repaining			Interval of constr. of new house		
	Pucca house (Brick or stone built)	Kachcha house	Grazing	Fodder	Fuelwood	Mahuda seeds	Mahuda flowers	Timru leaves	Gum	1to5 yrs	6to7 yrs	8to10 yrs	Within 5to10 yrs	Within 11to12 yrs	Within 13to15 yrs
Agaswan	-	20	16	16	20	-	-	-	-	20	-	-	4	9	7
Khervada	-	17	15	15	17	17	17	16	3	17	-	-	15	2	-
Malangdev	-	18	14	14	18	17	17	11	1	15	2	1	1	12	5
Tavali	-	15	10	10	15	15	-	-	-	15	-	-	3	-	12

and taking average that 1 head load is consumed within 3 days the per capita fuelwood consumption per year is [20 x 365]/[5 x 3 x 1000] Metric Tonnes (MT) i.e. 0.487 MT. This finding is quite close to one found in Wood Balance Study of 1984 (0.571 MT). Local villagers collect grass during monsoon period and a little after, from the plantations in forests on cut and carry basis. The survey found the 34% families 1 head load (20 kg), 42% families 2 head loads and 24% families collect 3 head loads per day (Fig. 3). Taking a weighted average we may find that every family collects 1.9 head loads every day.

Fig. 3



The dependence on MFP was also estimated. It was found that 16% families collect 2,000 bundles, 16% families collect 2,001 to 4,000 bundles and 7% families collect 4,001 to 6,000 bundles of Timru (*Diospyros melanoxylon*) leaves (Fig. 4) every year. They average out to be 1,150 bundles per family per year. Similarly 57% families collect about 20 to 40 kg, 11% families 41 to 60 kg and 2% families more than 60 kg of Mahuda seeds every year. The averaging gives that every family collects around 24 kg of Mahuda seeds every year. For Mahuda flowers, the families collecting 20 to 40 kg is 54%, between 41 to 60 kg is 9% and those collecting more than 60 kg is just 4%. So, on an average every family collects around 23 kg of Mahuda flower every year (Fig. 5).

Fig. 4

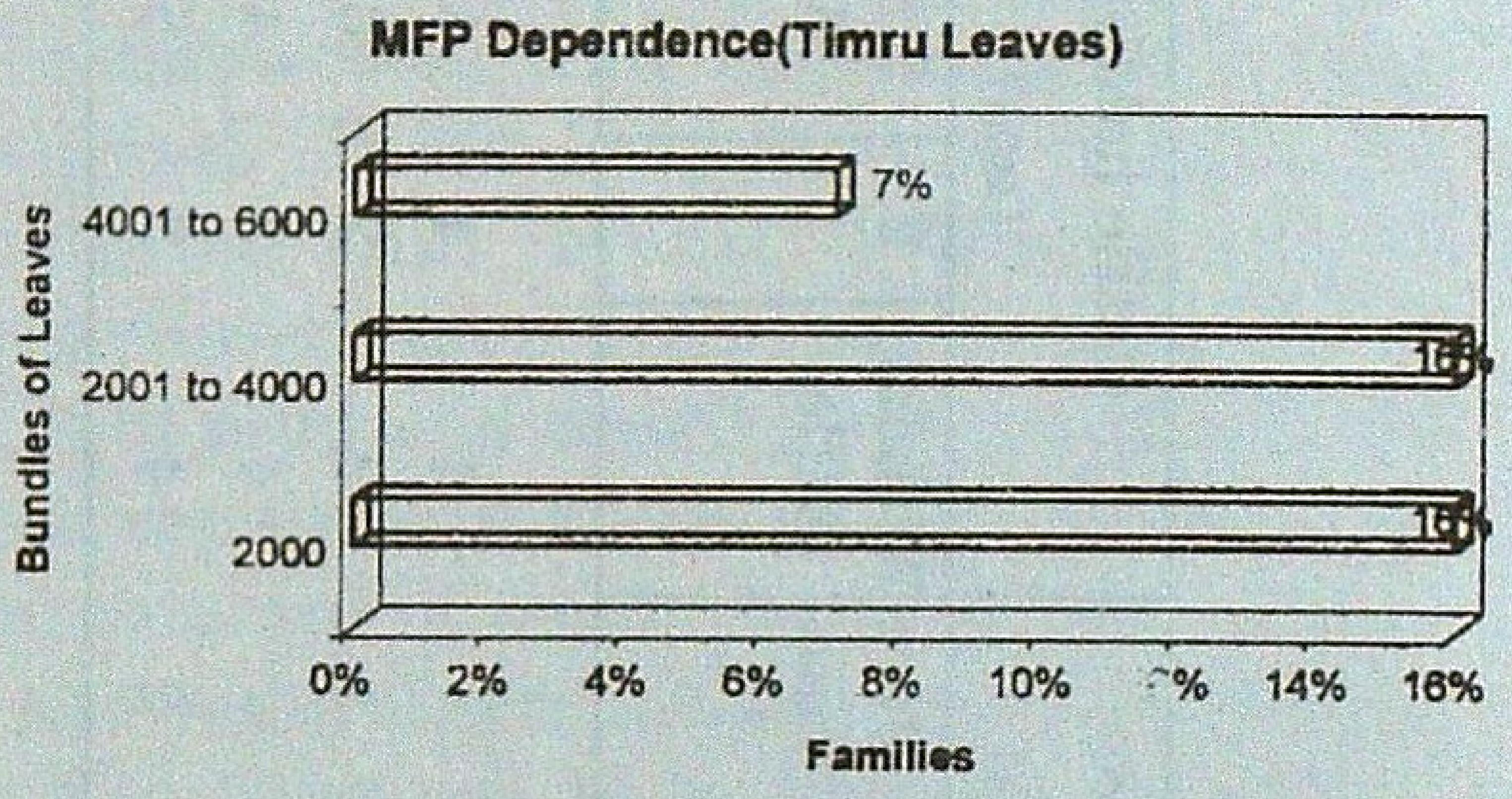
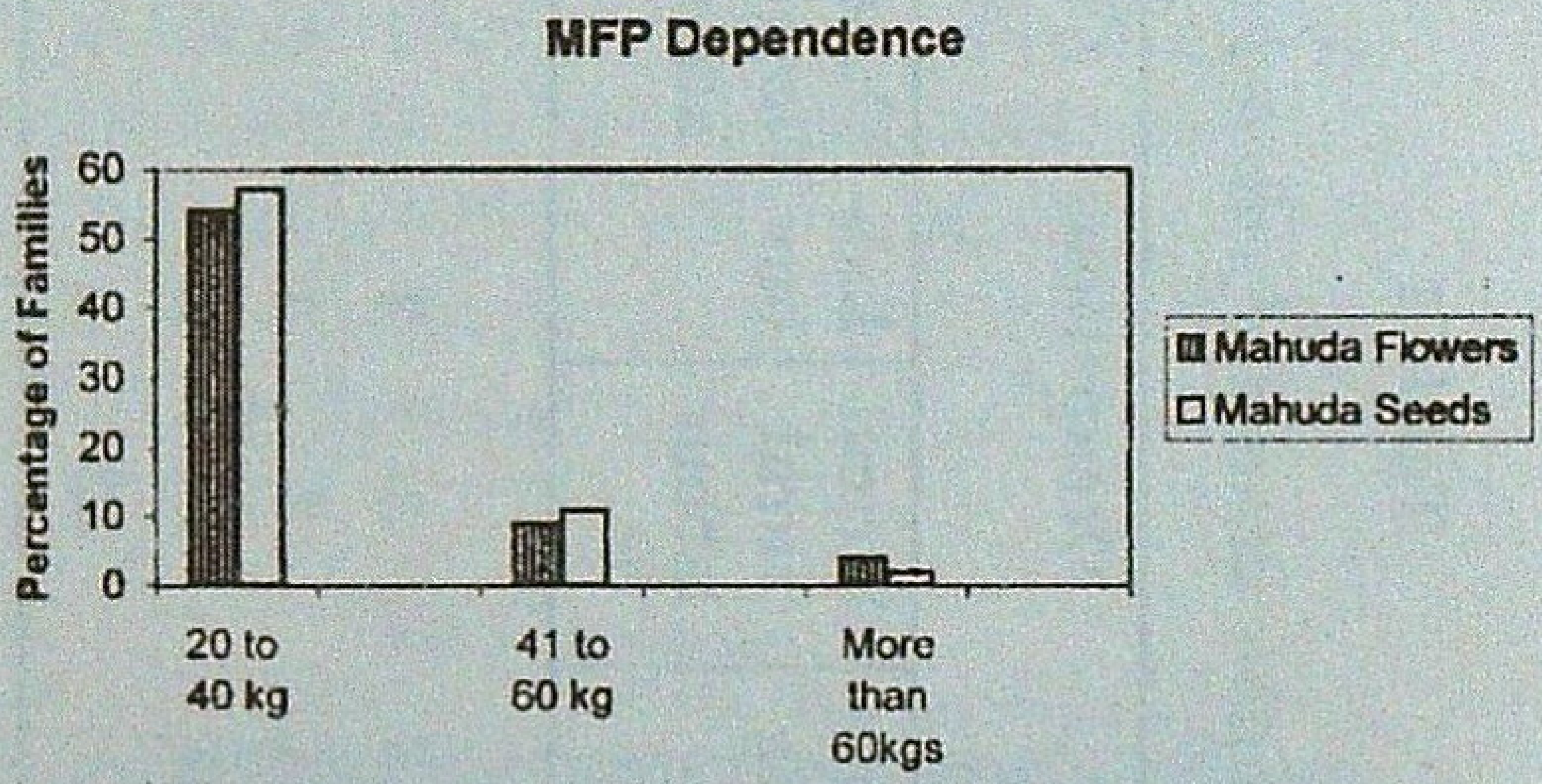
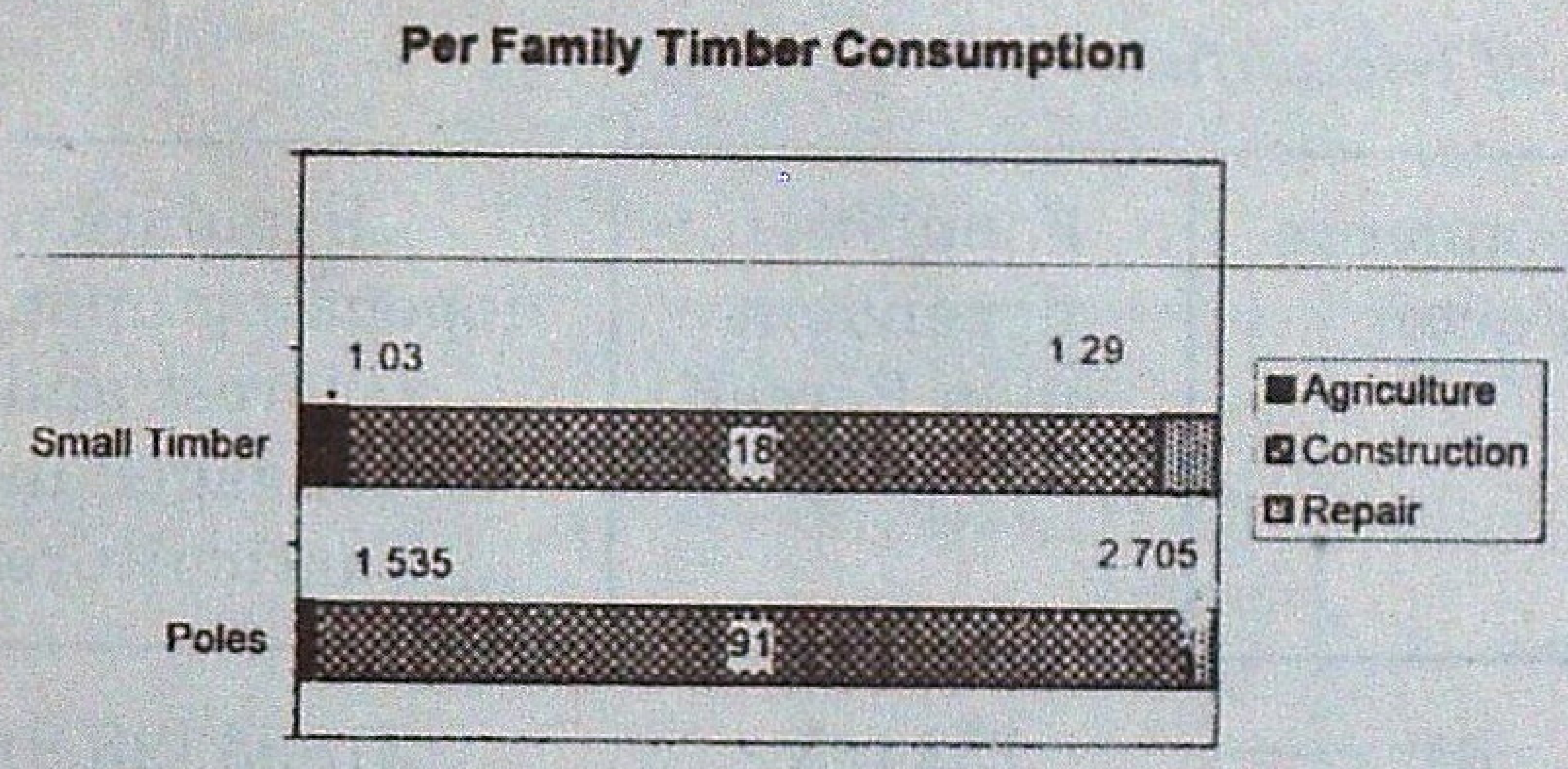


Fig. 5



Agriculture implements, house repairs and construction are three main items for which local population needs timber. The timber requirement for these purposes was also assessed during the survey. The survey shows that about 49% families need 1 to 2 poles and 20% families need 3 to 5 poles as well as 34% need 1 to 2 small timber and 13% families require 3 to 5 small timber for agriculture implements. Thus on an average a family needs 1.535 poles and 1.03 small timber for agriculture implement. Similarly, for house repair the average timber brought from forest per family is 2.705 poles and 1.29 small timbers and 34 bamboos. For the construction of new houses, the timber brought from forests

Fig. 6



comes on average 91 poles, 18 small timber and 619 bamboos. Fig. 6 shows the timber needs for agriculture, house construction and repair purposes.

Estimation of Fuelwood needs

The consumption of fuelwood is not the same for all sections of society. It depends upon the level of urbanisation, consumption pattern, availability of fuel types and distance from forests. However to assess the firewood needs the entire situation can be linked with a single factor i.e. availability of the forests. Adopting the presumption that dependence on forests for firewood would be 90% if the village/ locality has 40% forest area (Sarkar 1998). The dependence factor for population of various talukas falling under the Forest Command Area (FCA) of Vyara Forest Division is given in Column 4 of Table 3. An FCA or the Impact Zone (IZ) can be defined to be the area around the given patch or patches of forests from which commonly resident people are utilising various goods and services available from forests without incurring any cost since long (traditionally). Accordingly the dependent population is 3,59,798 and considering per capita consumption of 0.487 MT. The total firewood extracted from these forests wood be 1,75,222 MT.

Estimation of Timber

As discussed earlier timber requirement for agricultural implement per family with is 1.535 poles and 1.03 small timber. In accordance with Gujarat Forest Manual (Deshpandey, 1975), the average mid girth of pole is 34 cm and average length 6.5 m. Similarly, for small timber mid girth is taken as 67.5 cm and average length 4.25 m. Then quantity of wood, using quarter girth formula, will be :

1 Pole = 0.047 m^3
1 small timber = 0.121 m^3

The dependent families as detailed in column 5 of Table 3 will be 17,777 (considering 5 members constituting one family). If we assume that half of the families need small timber and poles for agricultural implement every year the requirement will be 8,889 (1.535 x 0.047 + 1.03 x 0.121) = 1749 m^3.

Similarly timber need for one house repair is (2.705 x 0.047 + 1.29 x 121) = 0.283 m^3. As per census data, on average 55% families of the district live in Kachcha houses. The survey finds that 96% families repair house within 1 to 5 year so annual repair may be 19.2% kachcha houses. Out of them 7% houses are reconstructed every year. The timber required will be 1366 m^3 and 1,64,169 bamboos.

In one house construction the timber brought from the forests is (91 x 0.047 + 18 x 0.121) m^3 = 6.455 m^3. In the survey of forest villages it has been found that Kachcha houses are constructed at least once in 15 years and hence about 7% houses are constructed every year. So 17,883 m^3 wood and 17,14,905 bamboos are required.

Table 3

Forest dependence of population

Taluka	Population	Forest Area (%)	Dependence Factor	Population dependent upon Forest	Population depending upon forest and engaged in agriculture
Vyara	218762	27.17	.61	133445	31893 (23.9)
Mahuwa	126097	7.17	.16	20176	2905 (14.4)
Valod	76965	0.92	.02	1540	199 (12.9)
Choryasi	1730833	0.06	0.001	1731	12 (0.67)
Songadh	172959	42.44	0.95	164311	45300 (27.57)
Nizar	94645	0.12	0.003	284	35 (12.26)
Uchhal	63639	26.79	0.602	38311	8543 (22.3)

Figures in bracket show the percentage of population categorised as farmers.
The dependence Factor is calculated from the presumption that 40% of total area under forests means 90% of dependence.

Grazing

Except for the monsoon when the cattle are used in agriculture works or they cannot be driven away to forests, the cattle of neighbouring villages graze in the open forest areas. They enter closed areas too. The grazing requirement can be calculated presuming that percentage of cattle grazing in the forest is equal to the percentage of forest area to total geographical area of the given taluka. Table 4 gives the conversion of total cattle population in different taluka in terms of standard cow heads. Table 5 details the total cow units grazing in the forest daily. The calculation shows that total fodder removal from the forest every year is about 67,000 MT, worth or Rs. 3.35 crores.

Grass collection

The survey finds that every family collects 1.9 head loads on average. The forest dependent population has been calculated to be 3,59,798. Annual collection of grass, assuming 60 days of collection every year would be :

= 60 x 1.9 x 71960 x 20 kg
= 1,64,069 MT

This collection is worth Rs. 8.2 crores at the price of Rs. 500/MT.

Supply position

A Working Plan exercise must try to match these local needs with the annual production.

Using remote sensing data of 1997, GEER Foundation, Gandhinagar has categorised the forests of Vyara Forest Division as given in Table 6.

Table 4

Taluka-wise cattle population in Vyara forest command area and conversion into standard cow units

Taluka	Cattle population				Std. Cow units
	Cows, Bullocks, Bulls	Calf	Buffaloes	Calf upto 3 yr	
Choryasi	11283	1753	42412	6692	62140
Valod	10816	2382	1394	4657	31449
Vyara	45146	8327	32914	13036	100423
Mahuwa	13163	3192	22586	8351	47292
Songadh	40692	6071	25542	9787	82092
Uchhal	18406	2850	8484	2773	32513
Nizar	16888	3409	14400	4644	39341
Total	156384	28982	159932	49940	395250

Conversion factors :

1. Every Cow, Bullock or Bull 1 Standard Cattle Head (Cow unit)
2. Buffalo - 2
3. Cow Calf - 1/2
4. Buffalo Calf (Upto 3 years) - 1

The wood biomass production has been calculated on the basis of FSI estimate that Central India's Forests' productivity is 1.05 m^3/ha/year and that of Indus Plain's Forests are producing on an average 0.4 m^3/ha/year.

So timber production = 79025.52 x 0.4
= 31,610.21 m^3

and firewood production = 79025.52 x 0.6
= 47415.31 m^3
or 34,358.9 MT

Table 5

Estimation of fodder removal

Taluka	Cow Unit	Percentage of Forest	Total c.u. grazing in forest daily
Choryasi	62140	0.06	37.0
Valod	31449	0.92	2.89
Vyara	100423	27.17	27285
Mahuwa	47292	7.17	3391
Songadh	82092	42.44	34840
Uchhal	32513	26.79	8710
Nizar	39341	0.12	47
Total			74599 Say 74600

If each Cow unit consumes 3 kg fodder from forest (other 2 kg is supplemented from outside forest) the total consumption = 74,600 x 3 kg
If grazing is 300 days the total fodder removed from forest is 74600 x 3 x 300 kg = 6,71,40,000 kg, say 67,140 MT
Considering Rs. 500/MT the cost is Rs. 3,33,50,000 i.e. 3.35 crores.

Table 6

Vyara Forest Division

Type	Area (ha)	Annual Biomass Production (m^3)
Dense	67198.93	70558.88
Open	15273.93	6109.57
Degraded	5892.68	2357.07
Highly degraded	4878.52	-
Blank, Water bodies, cultivation	1971.67	-
Total		79025.52

Balance Sheet

Vyara Forest's productivity and local consumption are as given below :

	Productivity	Local requirement
Timber (in m^3)	31610	20998
Firewood (in MT)	34359	175222

There is a deficit of 1,40,863 MT of fuelwood or 1,94,391 m^3 of firewood where as timber production could be about 10,612 m^3 over the local consumption. Hence it is necessary that management should look for more and more firewood production.

The committee appointed by the Government for studying and submitting their report on grazing policy has laid down certain guideline for the areas to be kept outside grazing or open to it. It has also given conversion units for different categories of bovine cattle as well as extent of various categories of area to support one cow unit of the bovine animal (Reddy, 1975). Based on these considerations, the carrying capacity for grazing is about 73,824 standard cow units. The grazing pressure is of about 74,599 cow units so it may be within the carrying capacity. However the area specific rotational grazing plan is needed to avoid uneven pressure on any specific locality as well as closure of area under plantation or regeneration should be strictly adhered to.

Conclusion and Recommendations

In the light of policy guidelines, satisfaction of the local needs of forest produce should be one of the important objectives and accordingly it finds place in the objectives of the Working Plan of this area (Verma, 1998). For bridging this gap between demand and supply of firewood, the management prescriptions would have to concentrate on increasing firewood productivity of the forests and also growing firewood outside the forest area under social forestry. Simultaneously wood substitution is to be encouraged along with methods for efficiency maximisation of firewood consumption. This would entail multi-pronged approach involving many agencies other than Forest Department also. Although mandate for involving other agencies does not lie within the purview of working plan, however, mention of such imperatives would provide ample guidelines for launching effective schemes in the future. Even within the ambit of forestry activities and other schemes or programmes under taken by the Forest Department, many efficacious remedies are possible. A few of them are indicated below and they have been accommodated to great extent in the concerned Working Plan :

(i) Proportions of firewood and MFP giving species have been considerably increased in the proposed plantations.

(ii) Increase in the social forestry activities in the tract with predominance of firewood species on government. and community wasteland has been recommended.

(iii) Silvicultural prescriptions to give intermittent supply of firewood material have been designed. For example, cut back operation, multiple shoot cutting, cleaning, pruning and thinning at shorter frequency in area regenerated from coppice would contribute to the firewood supply in the area.

(iv) Moderate delay in harvesting of mature trees would also add to the availability of firewood material in form of fallen twigs and branches.

(v) Awareness campaign to make the local people aware of the problems and promote willingness to take up alternatives like improved chullahs (hearths), biogas plants and solar cookers etc should be launched. Forest Department is presently already taking up these activities. The intensity, scale and effectivity of the programme need to be increased.

(vi) Fuel-efficient improved crematoria can be installed in local cremation sites.

(vii) Coverage of people's participation in forest management and the presently practiced Joint Forest Management (JFM) should be extended to involve larger number of local community in forest management and increase firewood productivity of degraded forests.

(viii) Residents of a few villages situated at the fringe of urban centers are found willing to take up cooking gas, if available at affordable price. Thought can be given to subsidise the cost and streamline the distribution of LPG in rural areas around forests.

(ix) In consistence with guidelines of National Forest Policy 1988, the forestry needs to be re-oriented for the purpose of conservation, sustenance and production in the ratio of about 60:30:10 (Agrawal and Verma, 1999). After due demarcation and identification of area on this line, the sustenance forestry area should be managed under JFM with objective of meeting local demands of forest product. The working plan gives express permit for JFM within the confines of prevailing rules and regulations.

Many other innovative alternatives, suitable to the local conditions can be suggested, for making the working plan provision efficacious enough to satisfy the forest produce needs of local tribal population and rural poor on sustainable basis.

SUMMARY

National Forest Policy, 1988 recognises the dependence of the forest dwelling population and other poor living within and near forests, on the local forest resource and prescribes and their domestic requirements of Fuelwood, Fodder, Minor Forest Produce and construction timber should be the first charge on forest produce. It is therefore necessary to estimate local demand of forest produce quantitatively while preparing or revising the Working Plan/ Management Plan of a forest area. The estimation would affect the quantity and quality of removals from the forest as well as guide the management prescriptions influencing species composition, rotation, harvesting regime and even cultural and tending operations. In this paper local requirement of forest produce in Vyara Forest Division area of Gujarat has been estimated on the basis of primary data collected through sample survey and secondary information available from existing reliable data base. It has been found that the area is self-

sufficient, so far as local demands of timber is concerned. However large demand-supply gap exists in case of firewood even in the well-wooded localities. The gap can be bridged up by increasing firewood productivity, maximising fuelwood efficiency and using substitutes of firewood. Increase in fuelwood and MFP giving species in the plantation, expansion of social forestry and JFM, delay in harvesting timber, installation of solar cooker, improved crematoria, improved earthen hearths and biogas plants, subsidised distribution of LPG in forested tracts and large scale awareness campaign have been recommended as methods for narrowing the demand supply gap of forest produce.

वनोपजों की स्थानीय मांग और कार्य योजना

(गुजरात के व्यारा वन मण्डल में किया गया एक अध्ययन)

ए०के० वर्मा

सारांश

राष्ट्रीय वन नीति, 1988 में वनों के अन्दर और उनके आस-पास रहने वाले अन्य निर्धन लोगों की स्थानीय वन संसाधनों पर निर्भरता को मान्यता दी गई है और उसमें यह प्रावधान किया गया है कि ईंधनकाष्ठ, चारा और अन्य छोटी-मोटी वनोपजों तथा इमारती लकड़ी के लिए उनकी घरेलू जरूरतों की पूर्ति को वनोपजों पर प्रथम मांग समझा जाना चाहिए । इसीलिए किसी वन क्षेत्र की कार्य योजना/प्रबन्ध योजना तैयार करते अथवा उसे संशोधित करते समय वनोपजों की स्थानीय मांग का मात्रात्मक अनुमान लगाना आवश्यक होता है । यह अनुमान वन से निकाली जाने वाली सामग्री की मात्रा और गुणवत्ता पर तो प्रभाव डालेगा ही किन्तु उसके साथ-साथ प्रबन्ध उपायों के अपनाने का दिग्दर्शक भी होगा जिसका प्रभाव वृक्ष-जातियों की रचना, आवर्तन, कटाई विधि यहां तक कि संवर्धन और परिपालन कार्यों पर भी पड़ेगा । प्रस्तुत अभिपत्र में नमूना सर्वेक्षण द्वारा इकट्ठा किए गए प्राथमिक आंकड़ों और उपलब्ध विश्वसनीय आंकड़ा-आधार से मिली द्वितीयक जानकारी से गुजरात के व्यारा वन मण्डल वन क्षेत्र की स्थानीय वनोपज जरूरतों का अनुमान लगाया गया है । इससे यह पता लगा है कि जहां तक स्थानीय जरूरतों की बात है, यह क्षेत्र उसमें आत्मनिर्भर है । किन्तु, भलीभांति जंगल लगी बस्तियों तक में ईंधनकाष्ठ की मांग और आपूर्ति के बीच काफी अन्तर विद्यमान है । यह अन्तर ईंधनकाष्ठ उत्पादकता को बढ़ाकर ईंधनकाष्ठ दक्षता को अधिकतम बनाकर और ईंधनकाष्ठ के बदल पदार्थ उपयोग में लाकर समाप्त किया जा सकता है । रोपवनों में ईंधनकाष्ठ और गौण वनोपज प्रदायक वृक्षजातियों को बढ़ाकर सौर चूल्हे तथा परिष्कृत अन्त्येष्टिगृह उपयोग में लाना मिट्टी के चूल्हों में सुधार करना और बायोगैस संयन्त्र लगाना, वन क्षेत्रों में एलपीजी का वितरण सहायता राशि देकर कराना तथा बड़े परिमाण पर जन जागरण अभियान चलाना वनोपजों की मांग और आपूर्ति के बीच की दूरी को कम करने के कुछ उपाय हैं जिन्हें अपनाने की सिफारिश इसमें की गई है ।

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STUDIES ON SEXUAL VARIATION IN CLONES OF *CASUARINA EQUISETIFOLIA* FORST

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Introduction

Casuarina equisetifolia Forst., a fast growing tree of multiple end uses is raised extensively by farmers and Forest Departments. Phenotypic variants are reported on this species throughout the distribution range in India on crown shape, branch angle, cladode length, size and shape of fruiting cones and seed morphology. (Anon., 1994). This tree flowers twice a year, once from February to April and again September to October, the fruits ripening in June and December. Male, female and monoecious trees are found in this species. Male flowers are produced in catkins and each flower consists of a single stamen enclosed in a pair of deciduous petals and two small bracteoles in the bud stage. The female flowers have no perianth and are produced in small cones. Each female flower consists of a single unilocular gynaecium formed from two carpels subtended by two lateral bracteoles and a bract (Troup, 1921). Generally, in a population 48 per cent of trees are male and 49 per cent female with 2 to 3 per cent being monoecious. Change of sex expression in this species is unreported though there are reports of change in sex expression in *Salix* species (Malyutina, 1973), *Morus nigra* (Jaiswal and Kumar, 1980) and *Acer* species (Matsui, 1995). The present study provides conclusive evidence for the first time that change in sex expression occurs in *C. equisetifolia*.

Material and Methods

Three to four year old plantations in Chengalpet and Chidambaram in Tamil Nadu were surveyed and extremely superior trees were selected and cloned using the cladodes (Gurumurthi and Bhandari, 1988). Ramets of these clones were established in the clone bank of Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore for selection and breeding work in the year 1992 (Kumar and Gurumurthi, 1996). Observation on various biometric and physiological parameters are being recorded at intervals of three months. The observations recorded during the month of September, 1997 and March, 1998 on flowering behaviour in the clones assembled from the Chengalpet and Chidambaram areas provided proof of change in sex expression in this species. Data on flowering were collected regularly and the plant samples analysed to study the variation in protein profiles during flowering and non-flowering seasons.

Results and Discussion

The population assembled from Chengalpet and Chidambaram consisted of clearly identified males, females and monoecious individuals at the time of introduction in the clone bank of IFGTB in 1992. Observations taken on flowering pattern from September, 1997 onwards proved that sex change had occurred in few clones. Constant males accounted for 59 per cent, constant females 26 per cent and constant monoecious individuals 4 per cent of the population. Six clones (11 per cent of the population) changed their sex in various ways (Table 1). Four clones viz., CHCE 1003, CHCE 2903, CPCE 0109 and CPCE 3702 were females originally and changed their sex to bisexuals. Clones CHCE 0401 and CPCE 3501 were originally males and transformed into monoecious plants by producing female cones approximately five years after introduction.

Studies were initiated to understand this rare phenomenon at the molecular level. Protein profiles of the inconstant individuals were compared with those of the constant males, constant females and monoecious individuals during the flowering season. Further studies were taken up during the non-flowering season also to test for variations in protein levels. Total crude protein levels were analyzed during the flowering (January to March) and non-flowering (July to August) seasons during the year 2000. It was observed that the two types of plants namely the constants and the inconstants differed remarkably with respect to their protein levels (Fig. 1).

Protein levels were as low as 9.62 and 8.68 mg/g fresh tissue in males and females respectively during the non-flowering seasons which increased drastically to 39.4 and 32.0 mg/g fresh tissue during flowering (almost 4 fold increase over the initial values). In monoecious individuals, the protein levels were comparatively higher during the flowering season, but the variation in protein levels between the flowering and non-flowering seasons were marginal.

In case of the inconstants, there was a remarkable change in protein levels. During flowering, the male plants, which changed their sex to inconstant individuals showed a 15 fold increase in protein levels when compared to the non-flowering season, while the female plants, which changed to inconstants showed a 10 fold increase. A reduction in protein content was noticed in the transformed plants when compared to the constant individuals at the time of flowering. But the rate of increase in protein levels in the transformants during flowering was almost thrice that of the normal plants. This may be effected as a result of the change in the sex expression in the transformants from either male or female to monoecious where it is required to produce female or male inflorescence additionally.

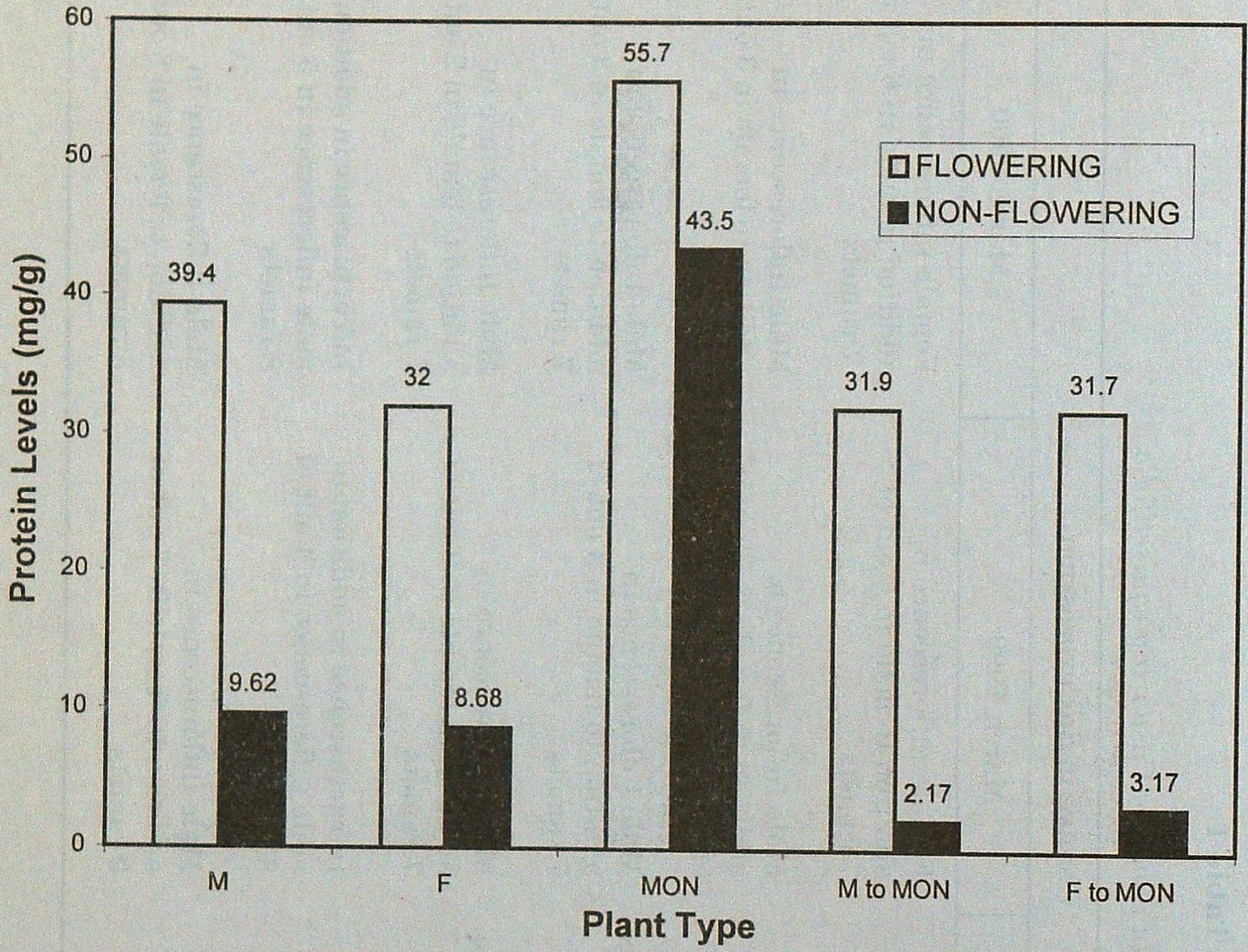
Continuous hedging done on the trees may be one of the reasons for this phenomenon of change in sex expression. Clones are maintained as hedges for production of several thousands planting stock using cladodes (Gurumurthi and Rawat, 1992). Malyutina (1973) studying the reasons for change of sex in *Salix* reported that the sex change is attributed not only to the very mutable nature of the

Table 1

Change in sex expression in clones of Casuarina equisetifolia

Clone Number	Sex when planted (1992)	Change in Sex expression		
		March 1998	March 1999	March 2000
CHCE 0401	Male	Female inflorescence in addition to male in 3 out of 7 ramets	Female inflorescence in addition to male in 6 out of 7 ramets	Female inflorescence in addition to male in 6 out of 7 ramets
CHCE 1003	Female	Male Inflorescence in addition to female in 3 out of 9 ramets	Male Inflorescence in addition to female in 3 out of of 9 ramets	Male Inflorescence in addition to female in 3 out of 9 ramets
CHCE 2903	Female	Iinitiation of Male Inflorescence addition to female in all the 7 ramets	Male Inflorescence in addition to female in 3 out of 7 ramets	Male Inflorescence in addition to female in 3 out of 7 ramets
CPCE 0109	Female	Initiation of Male Inflorescence addition to female in 3 out of 7 ramets	Male Inflorescence in addition to female in 2 out of 7 ramets	Male Inflorescence in addition to female in 2 out of 7 ramets
CPCE 3501	Male	Infructuscence in addition to male inflorescence in 2 out of 9 ramets	Infructuscence in addition to male inflorescence in 4 out of 8 ramets	Infructuscence in addition to male infloresence in 5 out of 8 ramets
CPCE 3702	Female	Male Inflorescence in addition to female in 5 out of 9 ramets	Male Inflorescence in addition to female in 7 out of 9 ramets	Male Inflorescence in addition to female in 8 out of 8 ramets

Fig. 1



Variations in protein levels in *Casuarina equisetifolia* during flowering and non-flowering seasons

M - Male F- Female Mon - Monoecious
M to Mon - Sex changed from male to monoecious
F to Mon - Sex changed from female to monoecious

reproductive organs in *Salix*, but also to the effect of unfavourable external influences including tree surgery. Jaiswal and Kumar (1980) reported that treatment of male plants of *Morus nigra* L. with 2 chloroethylphosphonic acid (ethophon) at concentrations in the range of 960-3840 mg/l induced the production of female flowers and intersexual flowers, which showed various degrees of transformation of male sex organs into female ones. Sex expression, sex change and fruiting habit in *Acer rufinerve* was studied by Matsui (1995) in Japan. Two types of flowers, functionally male and female were recognised. The adult population consisted of constant males, constant females and inconstants. Constant male plants that bore exclusively male flowers throughout the study period accounted for 87 per cent of the adult population. Plants accounting to eleven per cent of the population changed their sex in various ways and only 2 per cent of the population were comprised of constant females. When the dioecious species *Acer negundo, A. dasycarpum* and

A. monspessulanum were grown in an alien environment at the limits of their natural range, a sex change occurred in individual trees accompanied by parthenocarpy (Beskaravainaya, 1971). McArther *et al.* (1992) opined that the magnitude of sex change in trees is a product of the interaction of genetics and environment.

In the present study, the only external influence was continuous hedging of plants. It may however, be pointed out that though all the 103 clones are maintained as hedge orchards for planting stock production, only 11 per cent of the population showed change of sex termed as inconstants which may have evolutionary significance. Plant health and the successional stage of the stand need to be studied along with resource allocation to explain the proximate mechanisms of sex expression.

SUMMARY

Flowering pattern in sex identified clones of *Casuarina equisetifolia* Forst. grown as hedges in the clone bank of Institute of Forest Genetics and Tree Breeding, Coimbatore, India revealed that sex change occurs in this species. The population assembled and rooted ramets from three year old trees selected from Chengalpet and Chidambaram area of Tamil Nadu, India consisted of constant males, constant females and monoecious individuals at the time of introduction during 1992 and remained so till 1997. The data on flowering collected afterwards showed that constant males, constant females and monoeciouis individuals accounted for 59, 26 and 4 per cent of the population respectively. Six clones (11% of the population) changed their sex in various ways and became inconstant individuals. Studies on protein profiles undertaken during flowering and non-flowering seasons envisaged that the constants and inconstants differed remarkably with respect to their protein levels. Continuous hedging may bring out plasticity of sex expression in a small per cent of population.

कैजुआरिना इक्विसेटिफोलिया फौर्स्ट॰ के कृन्तकों में लैंगिक विभिन्नता का अध्ययन

कण्णन चन्द्रशेखर वारियर, के॰जी॰ अजित कुमार, रेखा आर॰ वारियर व के॰ गुरूमूर्ति

साराशं

कैजुआरिना इक्विसेटिफोलिया फौर्स्ट॰ के लिंग पहचाने कृन्तकों की, जिन्हें वन आनुवांशिकी एंव वृक्ष प्रजनन संस्थान, कोयम्बटूर के कृन्तक - कोश में झाड़ियों की तरह उगाया गया, पुष्पन सज्जा से पता चला कि इस वृक्षजाति में लिंग परिवर्तन होता है । तमिलनाडु, भारत के चिंगलपेट और चिदम्बरम क्षेत्रों के तीन - वर्षीय वृक्षों से चुने गए जड़ें निकले रैमेट से बनाई गई वृक्ष संख्या में 1992 में आरम्भन करते समय स्थिर नर, स्थिर मादा और उभयलिंगी पौधे ही लिए गए थे जो 1997 तक यथावत् बने रहे । तदुपरान्त एकत्रित पुष्पों के आंकड़ों ने दिखाया कि स्थिर नर, स्थिर मादा और उभयलिंगी पादपों की संख्या कुल वृक्ष संख्या की क्रमशः 59, 26 और 4 प्रतिशत थी । छह कृन्तकों (कुल वृक्ष संख्या का 11%) का विभिन्न तरीकों से लिंग परिवर्तन हो गया था और वे अस्थिर वृक्ष बन गए थे । पुष्पन और अपुष्पन समय में किए गए प्रोटीन स्थिति अध्ययनों ने दिखाया कि स्थिर और अस्थिर पादपों ने इनके प्रोटीन स्तरों की दृष्टि से बहुत अन्तर पाया जाता है । निरन्तर बाड़ लगाए रखने से वृक्षों के छोटे से प्रतिशत की लिंग अभिव्यक्ति में अभिघटन हो सकता है ।

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ON UPPER BIAS IN 'FOREST COVER' DATA OF HILLY TERRAIN OBTAINED THROUGH SATELLITE IMAGERY WITH SPECIAL REFERENCE TO MIZORAM

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Introduction

The 'State of Forest Report' (Anon., 1997) prepared by the Forest Survey of India (FSI), furnishes figures pertaining to the 'Forest Cover' and the 'Recorded Forest Area' for all the States and Union Territories (UTs) of the country. The report defines these two terms in the following manner :

Forest Cover : All lands with a tree canopy density of more than 10 per cent though they may not be statutorily notified as forest.

Recorded Forest Area : All lands statutorily notified as forest though they may not necessarily bear tree cover.

The 'Forest Cover' assessment is based on satellite data obtained through the 'Linear Imaging and self scanning' (LISS-II) sensor on board IRS-IB pertaining to the period 1993-94.

A majority of States/UTs has a 'Forest Cover' less than the 'Recorded Forest Area' except for seven - Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Andaman and Nicobar Islands. In these seven States/UT the observed 'Forest Cover' is significantly more than the 'Recorded Forest Area'. The relevant figures for these seven States/UT are shown in Table 1. Incidentally the physiography of all the seven States/UT is dominated by a hilly terrain.

Forest Cover

It is to be made clear that the term 'Forest Cover', as it appears in the State of the Forest Report 1997, stands for the estimated forest cover interpreted and measured on the basis of satellite data. It doe not stand for the true forest cover in the absolute sense of the term. The satellite data are being procured from the National Remote Sensing Agency (NRSA) in the form of False Colour Composites (FCC) and being interpreted manually and digitally. The FSI classifies the vegetation cover into three canopy density classes :

(i) Dense forest (Canopy density of 40 per cent and more,

Table 1

Geographical Area, 'Recorded Forest Area' and 'Forest Cover' for the seven States/UT

States/UT	Geographical Area (km^2)	Recorded Forest Area		Forest Cover	
		(km^2)	(%)	Area	(%)
Arunachal Pradesh	83743	51540	61.54	68602	81.9
Manipur	22327	15154	67.87	17418	78.0
Meghalaya	22429	9496	42.34	15657	69.8
Mizoram	21081	15935	75.59	18775	89.1
Nagaland	16579	8629	52.04	14221	85.8
Sikkim	7096	2650	37.34	3129	44.1
A & N Islands	8249	7171	86.93	7613	92.3

Source : (SFR) Anon., 1997

(ii) Open forest (Canopy density between 10 to 40 per cent), and

(iii) Scrub (Canopy density of less than 10 per cent).

Dense forest and Open forest taken together is being called 'Forest Cover'. The accuracy of cover classification in the interpreted map, as per State of the Forest Report 1995, is 95.4 per cent (Anon., 1995).

The term 'Forest Cover' needs to be analysed further in light of the different land forms, in particular, the two-nearly flat plains and hills. In regions having nearly flat land surface or hills of gentle slope, the 'Forest Cover' estimated through satellite data may be accepted as the true forest cover as the bias incorporated here is at a non-significant level of less than 5 per cent. However, in regions having hills of steep slope, besides the above mentioned bias, a significant amount of bias is incorporated due to the degradation in the ground resolution of detector. The degradation in the ground resolution changes the net amount of radiation received by the detector and consequently changes the intensity of the corresponding picture element (pixel) than what it should be. The amount of bias varies exponentially with respect to the steepness of the slope of hill surface. This aspect has been investigated with respect to the data on Mizoram.

Physiography of Mizoram

Mizoram, situated between 20° 58'20" and 22° 59'35" N Latitude and 92° 30'15" and 93° 15'20" E Longitude (Anon., 1996), is one of the seven North-Eastern of the Union of India. The geographical area of the State is 21,081 km^2 and that of its three constitutent districts is Aizawl District (12,588 km^2), Lunglei District (4,536 km^2) and Chhimtuipui District (3,957 km^2). The physiography of the State mainly consists of seven long, North-South traversing, closely packed, steep, parallel ranges with intervening valleys. These parallel ranges are broken into a number of small hills having steep slope from all the sides. The average height of hills varies from 300 m in the West to 1500 m in the East. Relatively flat plains are scarce, and are found in patches up to a height of 300 m. The severity of slope of hills in Mizoram can be gauged from Table 2 and Table 3, giving the distribution of the geographical area into different slope categories.

Table 2

Area under different categories of slope

Slope (%)	Area (km^2)	(%)
0-8	500.21	2.4
8-20	878.24	4.3
20-50	9331.68	45.3
50 and above	9883.69	48.0
Total	20593.82	100

Note : Excluding about 500 km^2 area under road, rivers, habitation, etc.
Source : Directorate of Agriculture, Government of Mizoram.

Table 3

Slope statistics of the study area in Mizoram

Slope	Area	
(%)	(km^2)	(%)
0-3	13.0	0.21
3-10	40.0	0.63
10-15	111.0	1.76
15-25	196.5	3.11
25-35	573.5	9.08
35-50	1975.0	31.27
50-100	1371.0	21.69
100 and above	2037.0	32.25
Total	6317.0	100.00

Source : Mizoram Remote Sensing Application Centre (MRSAC), Science, Technology and Environment Cell, Planning Department, Government of Mizoram.

Sensor and Image

In Remote Sensing detection and discrimination of objects or surface materials means detecting and recording of radiant energy reflected or emitted by objects or surface materials. Different objects return different amount and kind of energy, in the different bands of the electromagnetic spectrum, incident upon it. The most important part of the remote sensing data acquisition systems are the sensors and their recording systems. The 'Forest Cover' assessment of 1997 by FSI is based upon the data acquired through the sensor LISS-II.

LISS-II is a solid state push broom scanner capable of imaging in the visible and near-infrared region of the spectrum. The Spatial resolution of the sensor is 36.25 m on ground. The reflected energy sensed for each pixel by the detector is quantised into 128 levels. The ground swath for image is 74.2 km. It uses 4 arrays of 2048 detectors - one array for each spectral band. Thus giving 2048 pixels in each scan and there are 2048 total scan lines in one scene.

The pictorial record from a scanner appears to be continuous tone photograph, however, it is composed of a two dimensional array of discrete pixel. The intensity of pixel corresponds to the net 'brightness' or radiance measured electronically over the ground area corresponding to each pixel. The ground area corresponding to a pixel is known as Ground Resolution Element (GRE). Finer details of terrain features which fall within the GRE cannot be resolved or detected. In case of LISS-II the GRE is a square with a side 36.25 m.

In FCC objects with high reflectance in both green and infrared energy are seen red and objects with high reflectance in red energy are seen green. This is because a yellow filtered infrared film is used for forestry purposes. The classification of 'Forest Cover' into the different canopy density classes is based on the tonal difference in colour. Tone (or hue) represents the relative brightness or colour of objects on photographs. Without tonal differences, the shapes, patterns and textures of objects could not be discerned. Tone depends upon the intensity of pixel.

The first step towards digital image processing is the operations for image rectification and restoration. This involves initial processing of raw data to correct for geometric distortions, radiometric distortions and to eliminate noise.

Sources of geometric distortions ranges from variations in altitude, attitude, and velocity of the scanner platform, to factors such as panoramic distortion, earth curvature, atmospheric refraction, relief displacement and non-linearities in the sweep of the sensors Instantaneous Field of View (IFOV). Sources of radiometric distortions are, changes in scene illumination (due to seasonal position of sun relative to earth), atmospheric conditions, viewing geometry and instrumental response characteristics. The potential source of noise range from periodic drift, or malfunctioning of a detector, to electronic interference between sensor components to 'hiccups' in the data transmission and recording sequence.

None of these distortions takes into consideration the relative change in the amount of radiation received by a detector due to increase in area of GRE (degradation in ground resolution) caused by steep slope of surface.

The Bias

A detector of the sensor LISS-II has a ground resolution of 36.25 m. That is, the intensity of a pixel corresponds to the net radiation emanating from all objects on ground within a GRE of 1314.06 m^2 (1.314 x 10^{-3} km^2). The GRE remains almost constant for relatively flat plains. However, it increases significantly on surface having steep slope. The increase in GRE at a slope angle θ is shown in Fig. 1, assuming the satellite to be vertically up and the slope of surface is only in one direction. In Figure 1, H, represents the altitude of the satellite, h, represents the average altitude of hills in Mizoram and θ, represents the slope angle in degrees. The GRE of a detector is represented by ABCD and apparent GRE due to slope is represented by A'B'C'D'. The vertical projection of A'B'C'D' at the altitude h is represented by PQRS.

The ground resolution in the direction of slope will be called the Apparent Ground Resolution (AGR). In the present case, the AGR for a ground resolution of 36.25 m and for given H, h and θ is calculated using Pythagoras Theorem as,

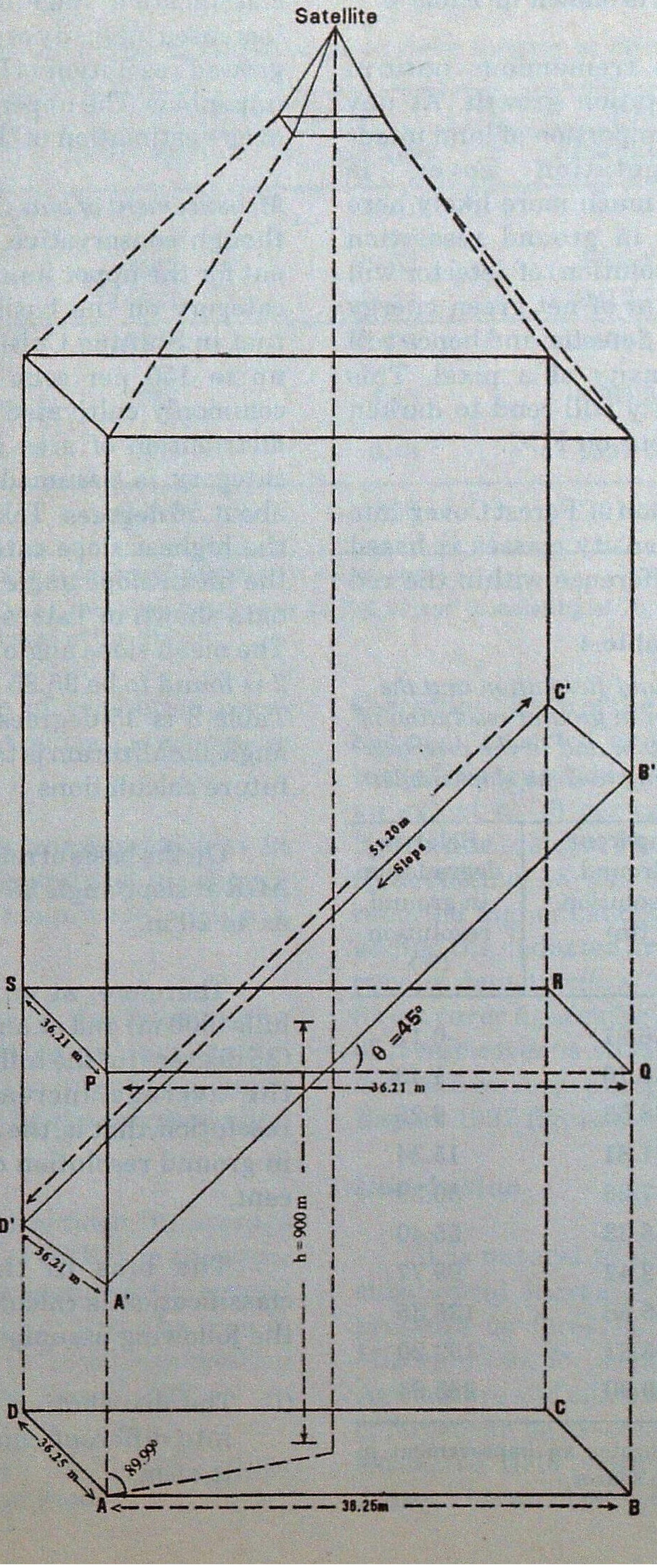
$$AGR = (1 - \frac{h}{H}) \times 36.25\ m \times \sec\theta$$

Taking, H = 900 km and h = 900 m,

$$\text{AGR} = 36.21 \times (\sec\theta)\ \text{m} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The Apparent ground resolution (AGR) and the relative degradation in the ground resolution of 36.25 m at an altitude

Fig. 1


Satellite
C'
B'
51.20m
Slope
S
R
θ =45°
36.21 m
P
Q
36.21 m
h=900m
D'
36.21 m
A'
D
C
36.25 m
89.99°
A
38.25m
B

h = 900 m, in the direction of slope for some of the slope angles is shown in Table 4.

Mizoram has tremendous natural potential for vegetation growth. At any point in time the proportion of land under inadequate vegetation cover is insignificant. It is much more likely here that the increase in ground resolution (degradation in resolution) of detector will increase the amount of net green energy contribution to the detector and hence will increase the intensity of a pixel. This increase in intensity will tend to darken the tone of red colour on FCC.

The classification of 'Forest Cover' into different canopy density classes is based up on the tonal difference within the red colour on FCC. At canopy density classification stage of 'Forest Cover' the increased intensity of pixel due to increased ground resolution is liable to introduce an upper bias. The upper bias will result in an over - estimation of 'Forest Cover'.

Table 4

The Apparent Ground Resolution and the Relative Degradation in ground resolution of the sensor at h = 900 m and in the direction of slope corresponding to some slope angles

Slope angle (degrees)	Apparent Ground Resolution (m)	Relative degradation in ground resolution (%)
0	36.21	-0.11*
10	36.76	1.40
20	38.53	6.28
30	41.81	15.34
40	47.26	30.39
50	56.33	55.40
60	72.42	99.77
65	85.68	136.35
70	105.87	192.20
75	139.90	285.94

*The negative sign indicates an improvement in ground resolution of the sensor.

Measurement of bias : First of all a realistic, though conservative, estimate is worked out for the upper limit of the highest slope category on the basis of the information that in Shifting Cultivation, "gradients of up to 150 per cent (56.30 degrees) are commonly cultivated" (Singh, 1996). The distribution of area in the highest slope category is assumed to be symmetrical about 56 degrees. Taking the mid value of the highest slope category as 56 degrees, the mean slope angle is calculated for the data shown in Tables 2 and 3, separately. The mean slope angle for the data in Table 2 is found to be 35.85 degrees and that for Table 3 is 35 degrees. The average slope angle for Mizoram is taken as 35 degrees in future calculations.

On the basis of relation (1), the average AGR at slope angle 35 degrees is calculated as 44.20 m.

Therefore, at an average altitude of hills (900 m) and at an average slope angle (35 degrees) of the hill surface in Mizoram, the average increase in the ground resolution, that is, the average degradation in ground resolution of a sensor is 22 per cent.

The bias in the reported cover classification is calculated on the basis of the following assumptions :

(i) The distribution of vegetation cover into different canopy density classes is even.

Table 5

Distribution of area into different forest cover category in Mizoram

Category	SFR-97 figures		Slope corrected figures	
	Area (km²)	per cent	Area (km²)	per cent
1. Forest cover :				
Dense forest	4348	20.62	3565.36	16.91
Open Forest	14427	68.44	12612.78	59.83
Total	18775	89.06	16178.14	76.74
2. Scrub	937	4.45	3365.20	15.97
3. Non-forest	1369	6.49	1537.66	7.29
Total	21081	100	21081	100

Result : 1. The overall bias in cover classification is 18 per cent.
2. The 'Forest Cover' corrected for slope is 16,178.14 km² (consisting of 76.74 per cent of the geographical area of the State).

(ii) The distribution of vegetation cover within different slope categories is even.

(iii) The slope under consideration is in one direction only and does not change drastically in magnitude within a GRE.

(iv) The slope caused degradation in ground resolution is increasing, proportionally, the intensity of green energy received by the corresponding pixel.

Under these assumptions, the average increase in the area of GRE is in the same proportion as the degradation in the ground resolution of the sensor. Also the bias in cover classification is in the same proportion as the increase in the area of GRE.

Hence, overall bias in cover classification is 18 per cent.

Correction : Each of the forest cover classes has been reported by an extent of 22 per cent of the true value and consequently by an extent of 18 per cent of the reported figure, due to slope. The correction consists of deducting 18 per cent area from the reported higher canopy density class, and adding the deducted area to the next lower canopy density class. The slope corrected forest cover figures for different categories of forest cover is shown in Table 5 along with the corresponding State of the Forest Report 1997 figures.

Conclusion

It is natural to think that due to the substantial increase in population, the pressure on forest is increasing here in Mizoram too, for securing more land for Agriculture and allied activities. The extent of forest can be assessed correctly through extensive field work only, however, at present for an observer into the State it is hard to accept the 'Forest Cover' figure provided by State of the Forest Report 1997. Regarding forest cover here the feeling of an expert is "The author feels that within the last 15 years, extent of wasteland had increased manifold. More than 50 per cent of total geographical area is now without any forest cover" (Jha, 1997).

The forest cover figure corrected for slope, seems to be more realistic. This figure is also supported by the relevant figures by Local Agencies. The bias in cover classification based upon satellite data can be reduced/eliminated either by improving the ground resolution of the sensor, or making regional standards for cover classification, or making proper correction based up on the ground truth, or the three together.

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SUMMARY

The high intensity of slope of hills in Mizoram causes a significant degradation in the ground resolution of the sensor of a satellite. Consequently, the intensity of the corresponding picture element gets increased in favour of higher canopy density class owing to the adequacy in the natural vegetational growth in the State. Hence, during cover classification stage, an upper bias is introduced. The present paper tries to investigate and measure the bias.

मिजोरम के विशेष सन्दर्भ में उपग्रह प्रतिबिम्बों द्वारा पहाड़ी भूमियों के 'वन आवरण' आंकड़ों में मिलती "ऊपरी अभिनति"

संजीव कुमार झा

सारांश

मिजोरम में पर्वतीय ढलान की अधिक चण्डता के कारण उपग्रह के सेंसर (संवेदक) में भूमि प्रतिबिम्बन में बहुत कमियां आ जातीं हैं । परिणामतः तत्सम्बन्धित चित्र के तत्व की चण्डता उस स्थिति में प्राकृतिक वनस्पतियों की पर्याप्तता के कारण अधिक वितान घनत्व वर्ग के पक्ष में बढ़ जाती है । इसीलिए, वृक्षावरण वर्गीकरण अवस्था में हमने 'ऊपरी अभिनति' को इसमें शामिल किया है । प्रस्तुत अभिपत्र में इस अभिनति के अन्वेषण और मापन का प्रयास किया गया है ।

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UNCARIA GAMBIER - A NEW SOURCE OF KATHA

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Introduction

Katha manufacturing, in India is an important forest based chemical industry which enables economic upliftment of both rural and urban people. Katha and Kutch are prepared mainly from the water extract of the heartwood of Khair tree (*Acacia catechu*). The hot aqueous extract gives two fractions when concentrated and cooled. A less soluble fraction separates out on cooling, gives a pale product called white Katha which is rich in stereoisomeric catechins of which the main constituent is (-) epicatechin (~85%) alongwith a small amount of (+) catechin (~8%) and traces of (+) epicatechin (Karnik *et al.*, 1973). The highly soluble portion of the water extract, when evaporated to dryness, gives dark Katha or the Kutch. Kutch is a complex mixture of high molecular weight, amorphous condensed tannins whose building units are catechins.

Production of Katha on all India basis is estimated to be around 40,000 cases/ month (each case is of 20 kg) giving an annual production of about 10,000 tonnes. This comprises of all grades of Katha and whatever goes in the name of Katha (Anon., 1999). The demand of Katha has been regularly growing and the growth has been exceptionally high in last 2 decades due to increase consumption of Pan Masala and Gutka.

Khair tree has been the only officially known source for production of Katha in India. To meet the increasing demand of Katha the demand for Khair wood has gone up. This has led to increase in felling of trees. In order to keep a check on deforestation, Government of India has restricted its felling which has resulted in a sharp increase in price of Khair wood, which has a multiplying effect on the price of Katha. Adulteration of Katha is being done by unscrupulous elements on a large scale to meet the gap between the demand and supply and also to control the rising cost of production of Katha. Public at large suffer due to consumption of harmful adulterated Katha.

Acacia catechu tree matures in about 25-30 years of exploitation and it appears practically impossible to reserve an area for plantation of Khair trees which would be sufficient for 25-30 years of requirement of Katha industry. Therefore, it was felt necessary to find an alternative source for the manufacture of Katha.

Uncaria gambier Roxb. (Hindi: 'Kath', 'Kutha') is cultivated in Malaysian countries for the production of gambier used for tanning leather. About six species of *Uncaria* have been recorded in India. Gambier is very much similar to cutch or dark catechu obtained from *Acacia catechu*. Extraction is done by boiling the young shoots and leaves in water and the decoction is evaporated to a specific consistency and allowed to cool and solidify into agglutinated cubes, which are the usual commercial forms of gambier. Externally, the cubes are light brown to almost black, but the freshly broken surface is pale cinnamon brown (Anon., 1976).

Gambier sample testing data from production centre, West Sumatra (Anon., 1999) and exported to other countries shows that :

- The catechin content and moisture content are in accordance with the standard.
- The ash content, the insoluble matter content in water and in alcohol do not comply with the standard.
- Quality standard in general is not yet comply with the quality terms.

Therefore, the material imported in the country includes non-gambier material. Gambier is exported in two forms viz. raw gambier (by China, Singapore, France, Monaco, Peru etc) and processed gambier (by Indonesia, Argentina, South Africa, Brazil, France, Monaco etc). Main importers of gambier from Indonesia are India, Singapore, Vietnam, Pakistan, Malaysia, Taiwan, Japan and Bangladesh. Gambier maintains its importance as a masticatory in South-East Asia and less as a tanning material. Gambier has never been used on a large scale in local tanneries in South East Asia (Lemmens and Wulijarni, 1991).

There are no adverse reports available against the use of gambier for human consumption. In the USA, gambier is regarded as a safe food additive and has been classified as 'GRAS' (Generally Recognised As Safe) under Federal Food, Drug and Cosmetic Act (FDA 121.1163). In Japan gambier is an approved non-chemically synthesised food additives under the Sanitation Law 1995.

Process for the preparation of *U. gambier* Katha

The production of Katha from the heartwood of Khair (*Acacia catechu* Wild) tree is very well known. The suitability of raw material for the preparation of Katha is based on the availability of catechin, the essential constituent present in Katha. Wood containing more than 3% of catechin is generally regarded as a suitable raw material for Katha.

Gambier agglutinated cubes available in the market contain non-gambier impurities like sand, coal, glass, polyethylene etc. Gambier when cooked in water gives a paste of pale cinnamon colour which shows ungelatinised granules under microscope (10x). It also shows the presence of green colour, commonly known as chlorophyll, but is on account of fluorescent substances present in gambier. The mixture of fluorescent material (crude yield 0.05%) consists of gambier tannin (m.p. 150-153°C), oxogambier tannin (m.p. 205°C), and 3, 14-dihydroxygambier tannin (m.p. 163°C) (Dhungat, 1999). pH of the 1% solution of gambier and Khair Katha in distilled water is 5.16 and 3.48, respectively.

Objective of the Invention

The objective of this invention is to develop a process for the preparation of

Katha from gambier extract, having a greater catechin content than known from the prior art (*A. catechu*), lesser amount of ash, and heavy metals.

Description of the Invention

Process of making gambier Katha revolves around the change of (+) isomer to (-) isomer of gambier catechin and removal of fluorescent substances (Soni, 1998).

Process for the preparation of Katha comprises following steps :

(i) Subjecting purified extract of gambier to a reaction to change (+) isomer of catechin to (-) isomer of catechin.
(ii) Treating the gambier solution (step i) with a decolourising agent,
(iii) Concentrating the solution of step (ii).
(iv) Cooling the solution (5-10°C) overnight to crystallise the Katha.
(v) Filtering/pressing, cutting, and drying of Katha.
(vi) Yield of Katha is approximately 34-36 per cent.
(vii) Yield of Cutch (gambier tannin) is approximately 35-40 per cent.

Product Characteristics

Characteristics of gambier Katha made by above process on comparison with *A. catechu* Katha are given in Table 1.

Characteristics of Catechin

Acacia catechu catechin isolated from Katha is an irregular shaped crystalline substance of greyish white colour, m.p. 230-235°C, $(\alpha)^{28}$ - 32.0° (C, 0.5 in alcohol), odourless, sweetish in taste and has an ash content of about 0.22 per cent.

Table 1

	Gambier Katha	*A. catechu* Katha (Gr.I)
Moisture content (%)	10-13	12
Catechin content (%) by wt.	79.3	55
Total ash (on dry basis) % by wt.	0.28	1.3
Acid insoluble ash % by wt.	Nil	0.50
Matter insoluble in rectified spirit (%)	0.80	25
Boiling water insolubles (%)	Nil	3.0
Arsenic (as As), ppm	0.04	1.0
Lead (as Pb), ppm	< 1.0	2.5
Copper (as Cu), ppm	< 1.0	30
Tin (as Sn), ppm	< 10.0	250
Zinc (as Zn), ppm	< 1.0	50

Catechin isolated from *U. gambier* extract is amorphous substance of greyish white colour, m.p. 88-90°C, $(\alpha)^{30}$ + 4° (C, 0.5 in alcohol). Catechin isolated from gambier katha prepared by above process is of white colour having a pinkish tinge, m.p. 138-142°C, $(\alpha)^{30}$ - 4.0° (C, 0.5); - 12.0° (C, 0.25); - 16.0° (C, 0.125% in alcohol).

Toxicity Evaluation

Katha prepared from *U. gambier* was evaluated for oral toxicity and oral mucosa toxicity by conducting tests on rats (*Rattus rattus albanicus*), strain wistar. Acute oral toxicity (LD_{50}) in male and female rats was determined as >5000 mg/kg Body Weight. Oral mucosa test shows irritation score = 0 i.e. very mild irritant to the oral mucosa of albino rats.

SUMMARY

Katha manufacturing in India is an important forest based chemical industry which enables economical upliftment of both rural and urban people. *Uncaria gambier* Roxb. is cultivated in Malaysian countries for the production of gambier used for tanning leather. Gambier is very much similar to Cutch or dark catechu obtained from *A. catechu*. Gambier maintains its importance as a masticatory in South East Asia and less as a tanning material. There are no adverse reports available against the use of gambier for human consumption. Process for the preparation of Katha from *U. gambier* extract having more catechins and yield with less, insolubles and heavy metals than *A. catechu* is reported. Product was evaluated for oral and oral mucosa toxicity and found non-toxic. Physico-chemical characteristic of gambier Katha is better than Khair Katha.

कत्थे का नया स्रोत – *उनकेरिया गैम्बीयर*

पी०एल० सोनी व एच०डब्लू० शर्मा

सारांश

कत्था बनाना भारत का महत्वपूर्ण वनाधारित रसायन उद्योग है जिससे ग्रामीण और शहरी दोनों तरह के लोगों की आर्थिक उन्नति होती है । मलेयाशयई देशों में *उनकेरिया गैम्बीयर* राक्स० की गैम्बीयर उत्पादन के लिए खेती की जाती है जिसे चमड़ा रंगाई (संशोधन) के लिए उपयोग किया जाता है । गैम्बीयर बहुत कुछ कच या गाढ़े रंग के कत्थे (केटेच्यु) जैसा ही होता है जिसे *अ० केटेच्यु* से निकाला जाता है । दक्षिण पूर्व एशिया में गैम्बीयर का महत्व चर्म संशोधन पदार्थ के रूप में कम परन्तु मुंह में डाल चबाने के लिए ही ज्यादा है । मानव उपभोग के लिए गैम्बीयर का उपयोग किए जाने से कोई हानि पंहुचने की कोई प्रतिकूल रिपोर्ट मिलने की जानकारी नहीं है । *उ० गैम्बीयर* निस्सार से कत्था बनाने की विधि, जिसमें केटेचिन अधिक होते हैं, प्राप्ति ज्यादा मिलती है, राख अविलेय पदार्थ और माटी धातु *अ० केटेच्यु* की अपेक्षा कम होते हैं, सूचित्त की गई है । यह उत्पाद खाने और खाने पर उठने वाले झाग की विषाक्तता जानने के लिए मूल्यांकित करने पर विषाक्तता-विहिन पाया गया । गैम्बीयर कत्थे की भौतरसायनिक विशेषताएं भी खैर-कत्थे की विशेषताओं से कहीं ज्यादा अच्छी होती हैं ।

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FOREST SOIL : VEGETATION RELATIONSHIP IN MUSSOORIE FOREST DIVISION (UTTARANCHAL)

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Introduction

The relationship between soil and vegetation has been very important for natural woodland ecosystem. Vegetation once established naturally or man-made modifies the soil development processes due to the parent material, topography, climatic conditions, inter-alia etc., minimizing soil erosion and by changing hydrology of the watersheds. Hence, the soil and vegetation relationship is dynamic as well as temporal. Various studies with regards to soil and their correlation with plant growth have been carried out in the deciduous forests of the country (Singhal *et al.*, 1980; Singhal and Sharma, 1985; Samra *et al.*, 1985; Minhas *et al.*, 1997). However, the information on these aspects especially in the Garhwal Himalayas of Mussoorie Forest Division is scanty. This study was, therefore, taken up to understand soil formation in relation to forest vegetation in the moist temperate forests and moist deciduous forests of Raipur range.

Material and Methods

Morphological and other properties of the soils developed under different forest vegetation in the moist temperate and deciduous forests of Mussoorie Forest Division, Uttaranchal were studied. Raipur range of Mussoorie Forest Division is located between 30° 15' 30" to 30° 27' 20" N latitude and 78° 03' 40" to 78° 18' 20" E longitude. The moist temperate forest zone selected for the present investigation comprises blocks of Ringalgarh and Sripur and moist deciduous forests comprise Mahipur, Rajpur, Raipur, Dwara and Ladpur blocks. In all seven representative sites under different vegetation at varying altitudes (800 to 2,000 m) were selected for soil profile examination. The morphological characters were studied as per the procedure outlined in the Soil Manual (Anon., 1975). The salient site characteristics are described in Table 1 and the morphological characteristics of different soil profiles are presented schematically in Figs. 1 and 2. Analyses of the processed soil was determined as per the methods described by Black (1965) and Jackson (1967).

Results and Discussion

Effect of Vegetation : Soils developed under *Pinus roxburghii* had yellowish brown A

Table 1

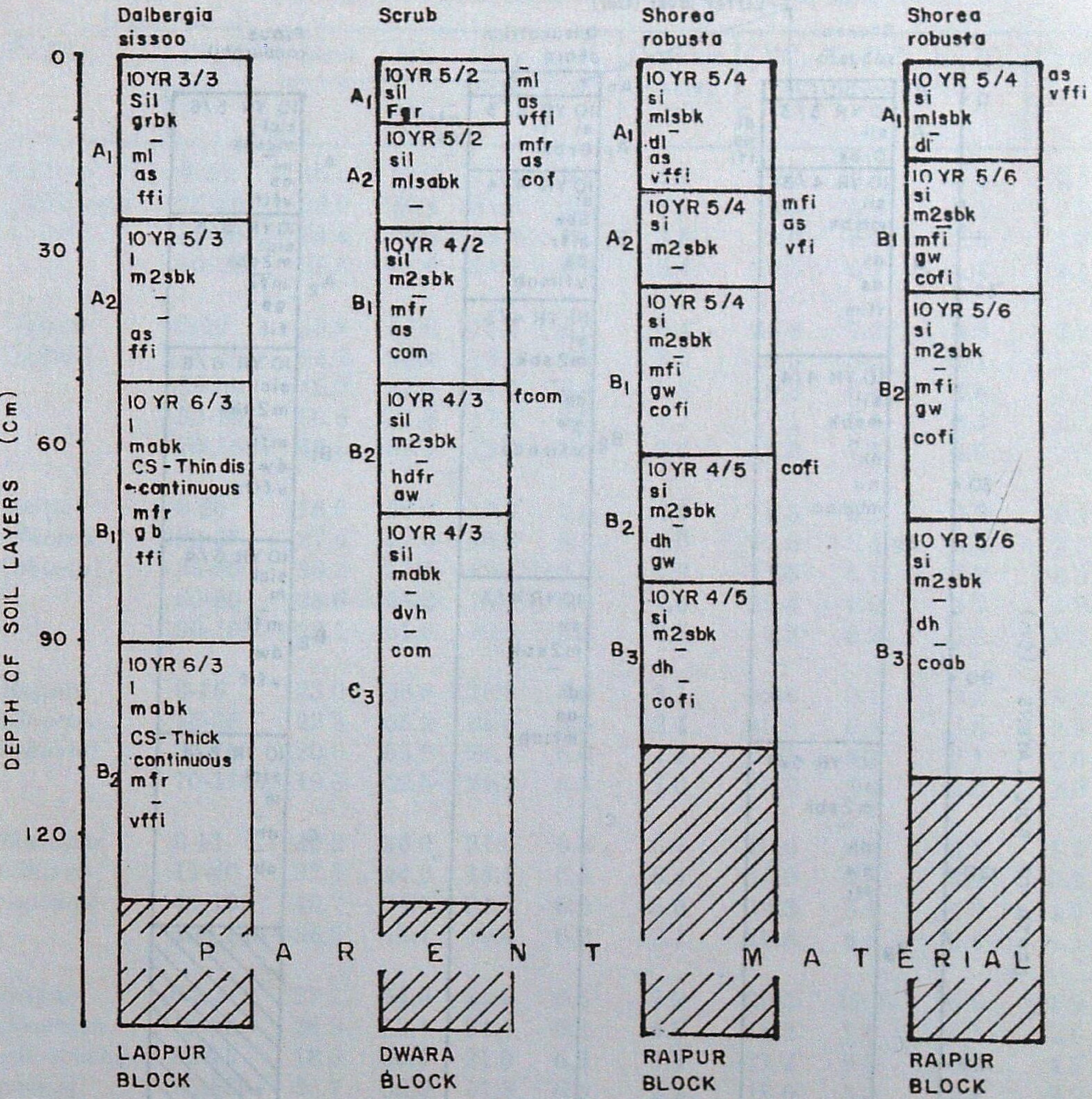
Salient site characteristics of studied profiles

Location	Elevation(m)	Landform	Parent material	Vegetation
Ladpur	800	Topland Slope - 2-3%	Limestone, boulders and quartzite	*Dalbergia sissoo*
Dwara	900	Topland Slope-10%	Limestone	Scrub
Raipur	1000	Mountainous Slope - 30%	Limestone and boulders	*Shorea robusta*
Rajpur	1100	Mountainous Slope - 30%	Limestone and boulders	*Shorea robusta*
Mahipur	1200	Mountainous Slope-20-25%	Slate, limestone and shales	*Shorea robusta*
Sripur	1500	Mountainous Slope-30-35%	Slate	*Quercus leucotrichophora*
Ringalgarh	2000	Mountainous Slope-20-25%	Limestone	*Pinus roxburghii*

horizon and dark yellowish brown B horizon. Soil under vegetative cover of *Quercus leucotrichophora* had A and B horizons of dark yellowish brown colour (Fig. 2). In case of soils formed under *Shorea robusta*, A horizon had dark yellowish brown colour and yellowish brown B horizon. Soil developed under Scrub vegetation had greyish brown B horizon. The soils under vegetative cover of *Dalbergia sissoo* had dark brown A horizon and B horizon of pale brown colour (Fig. 1). The lower values and chromas of the soils formed under *Pinus roxburghii* and *Quercus leucotrichophora* (Ringalgarh and Sripur blocks) is attributed to the addition of leaf litter annually and slow decomposition of organic residue under low temperature resulting in the accumulation of humus and organic matter. Minhas and Bora (1982) observed increase in organic matter with increase in altitude in the soils of Himachal Pradesh. The effect of different forest vegetation on soil properties has been amply demonstrated by Banerjee *et al*. (1991), Singhal *et al*. (1987), etc.

The formation of granular structure under different forest species might be due to high organic matter content. The soils of Ladpur block show thin and thick continuous clay skins and had block mottles in B horizon (Fig. 1). This may be due to alternate wetting and drying of these soils developed under high rainfall and flat topography. Such morphological features were, however, not seen in soils under *Quercus leucotrichophora, Pinus*

Fig. 1

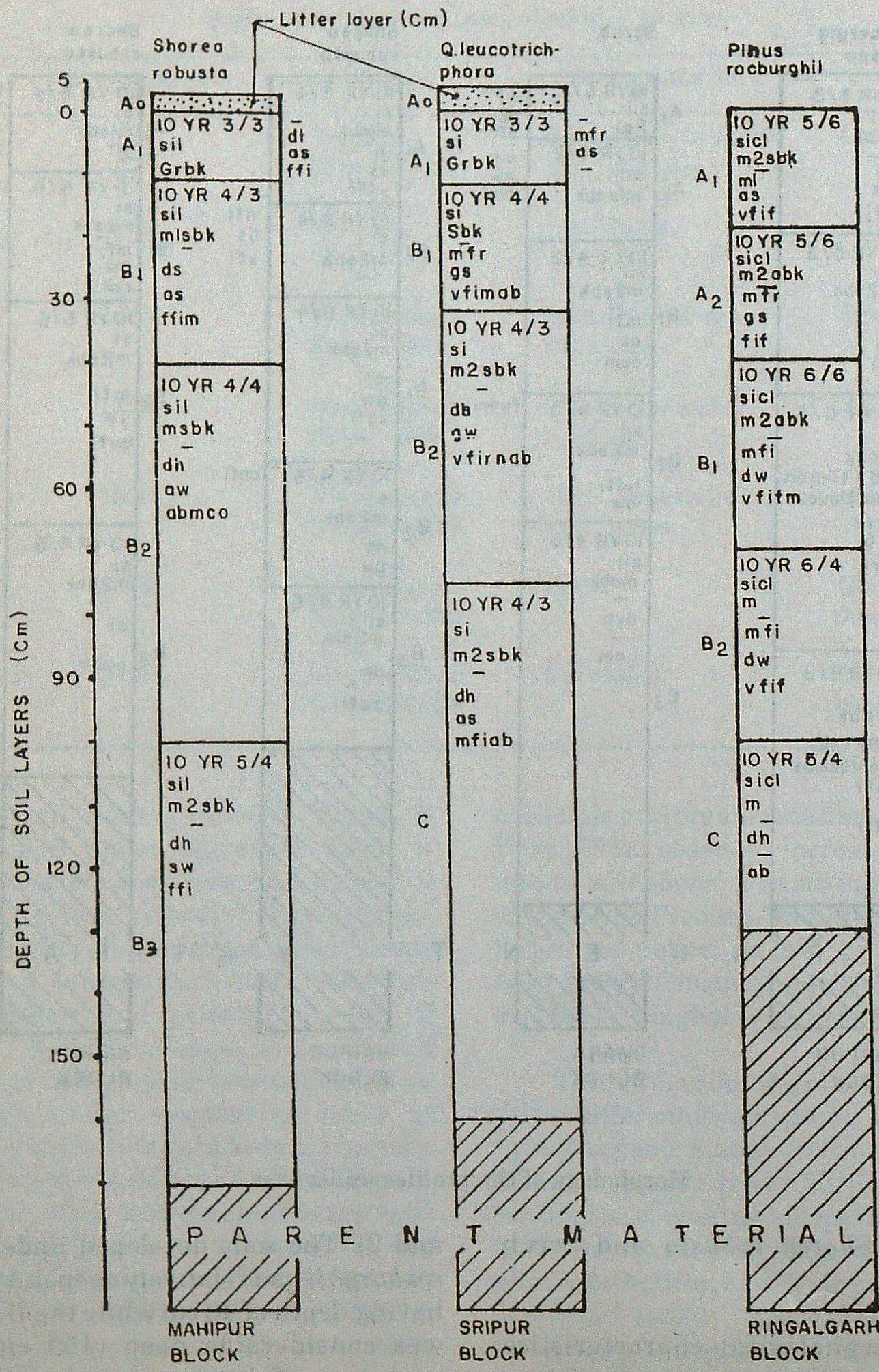

Dalbergia sissoo
Scrub
Shorea robusta
Shorea robusta
DEPTH OF SOIL LAYERS (Cm)
0
30
60
90
120
10YR 3/3 Sil grbk ml as ffi
A1
10YR 5/3 l m2sbk as ffi
A2
10 YR 6/3 l mabk CS - Thin discontinuous mfr gb ffi
B1
10YR 6/3 l mabk CS- Thick continuous mfr vffi
B2
10YR 5/2 sil Fgr
ml as vffi
A1
10YR 5/2 sil mlsabk
mfr as cof
A2
10YR 4/2 sil m2sbk mfr as com
B1
10YR 4/3 sil m2sbk hdfr aw
fcom
B2
10YR 4/3 sil mabk dvh com
C3
10 YR 5/4 si mlsbk dl as vffi
A1
10YR 5/4 si m2sbk
mfi as vfi
A2
10 YR 5/4 si m2sbk mfi gw cofi
B1
10YR 4/5 si m2sbk dh gw
cofi
B2
10 YR 4/5 si m2sbk dh cofi
B3
10 YR 5/4 si mlsbk dl
as vffi
A1
10 YR 5/6 si m2sbk mfi gw cofi
B1
10 YR 5/6 si m2sbk mfi gw cofi
B2
10 YR 5/6 si m2sbk dh coab
B3
PARENT MATERIAL
LADPUR BLOCK
DWARA BLOCK
RAIPUR BLOCK
RAIPUR BLOCK

Morphology of the profiles under test

roxburghii, Shorea robusta and Scrub vegetation.

The morphological characteristics show considerable variation in the nature and degree of horizon development (Figs. 1 and 2). The soils developed under *Pinus roxburghii* had relatively deeper A horizon having depth of 40 cm while the B horizon was considerable deep (100 cm). The sequence of horizons under *Quercus leucotrichophora* was A0-A1-B1-B2-C in

Fig. 2


Litter layer (Cm)
Shorea robusta
Q. leucotrichphora
Pinus rocburghii
DEPTH OF SOIL LAYERS (Cm)
5
0
30
60
90
120
150
Ao
A1
B1
B2
B3
10 YR 3/3 sil Grbk
dl as ffi
10 YR 4/3 sil mlsbk ds as ffim
10 YR 4/4 sil msbk dh aw abmco
10 YR 5/4 sil m2sbk dh sw ffi
Ao
A1
B1
B2
C
10 YR 3/3 si Grbk
mfr as
10 YR 4/4 si Sbk mfr gs vfimab
10 YR 4/3 si m2sbk db aw vfirnab
10 YR 4/3 si m2sbk dh as mfiab
A1
A2
B1
B2
C
10 YR 5/6 sicl m2sbk ml as vfif
10 YR 5/6 sicl m2abk mfr gs fif
10 YR 6/6 sicl m2abk mfi dw vfifm
10 YR 6/4 sicl m mfi dw vfif
10 YR 5/4 sicl m dh ab
PARENT MATERIAL
MAHIPUR BLOCK
SRIPUR BLOCK
RINGALGARH BLOCK

Morphology of the profiles under test

Table 2

Physical and chemical characteristics of the soils

Profile	Depth (cm)	Sand	Silt	Clay	pH	Organic Matter (%)	CEC	Ex.Ca^{2+}	Ex.Mg	Ca:Mg	BS (%)
		(%)					(cmol(p+)kg^{-1})				
Ladpur (*Dalbergia sissoo*)	0-25	46.0	42.2	11.4	6.5	6.2	19.0	6.5	3.1	2.1	52.1
	25-50	58.0	20.4	21.6	5.5	5.3	13.5	5.6	2.1	2.7	58.5
	50-90	64.4	20.2	15.4	6.0	3.8	13.0	4.3	2.3	1.9	52.3
	90-130	63.8	23.0	13.2	6.0	3.4	17.5	5.7	1.4	4.1	42.3
Dwara (Scrub)	0-10	53.9	30.6	15.5	6.5	6.4	24.8	7.3	3.3	2.2	43.9
	10-26	53.7	32.4	13.9	6.2	6.0	16.0	5.2	4.1	1.3	59.3
	26-50	42.2	43.0	14.8	6.4	5.3	19.3	6.4	3.4	1.9	51.8
	50-70	50.6	31.8	17.6	6.2	4.7	17.1	5.1	2.3	2.2	44.4
	70-130+	48.6	38.1	13.3	6.5	3.4	12.6	7.2	3.5	2.0	88.0
Raipur (*Shorea robusta*)	0-20	25.0	56.6	18.4	5.5	3.9	14.5	6.9	2.9	2.3	61.1
	20-35	27.4	52.6	20.0	5.5	3.0	12.6	5.4	2.5	2.1	65.6
	35-60	30.2	50.5	19.3	5.8	1.9	11.5	5.1	2.2	2.3	60.3
	60-80	28.6	53.2	18.2	6.0	1.6	10.4	6.0	3.1	1.9	64.4
	80-105	29.1	51.3	19.6	5.6	0.5	8.3	6.2	3.0	2.1	66.6
Rajpur (*Shorea robusta*)	0-15	23.0	58.8	18.2	6.0	3.1	12.6	7.1	3.2	2.2	52.8
	15-35	22.3	55.2	22.5	5.5	2.4	10.9	6.9	2.8	2.5	62.7
	35-70	20.6	55.0	24.4	5.0	1.2	9.5	4.3	2.1	2.0	55.3
	70-110+	19.3	59.5	21.3	5.5	1.0	8.9	5.4	2.6	2.0	53.1
Mahipur (*Shorea robusta*)	0-11	30.2	40.0	21.6	6.8	6.7	20.0	9.6	5.1	1.9	52.0
	11-40	37.1	44.8	18.1	6.5	6.4	16.0	4.8	4.9	0.9	62.5
	40-100	40.7	34.6	24.7	6.0	5.5	14.3	5.6	4.3	1.3	70.6
	100-170+	38.5	42.1	19.4	6.2	2.1	12.6	4.3	3.8	1.1	66.7
Sripur (*Quercus leucotrichophora*)	0-12	27.2	51.8	20.9	6.5	7.9	20.5	10.7	5.6	1.9	64.3
	12-32	26.2	52.4	24.4	6.2	5.5	19.1	7.6	4.1	1.8	62.3
	32-75	18.3	60.7	21.0	6.5	3.4	21.2	6.3	3.6	1.7	48.1
	75-160+	30.7	58.0	11.3	6.0	2.2	19.5	5.4	2.4	2.2	41.0
Ringalgarh (*Pinus roxburghii*)	0-19	14.5	59.1	26.3	6.5	7.2	25.5	8.6	4.3	2.0	51.4
	19-40	15.5	59.0	25.5	6.0	4.5	23.4	7.5	2.1	3.6	41.9
	40-70	14.6	55.7	29.7	6.4	0.7	18.3	6.4	2.9	2.2	51.9
	70-100	15.2	57.6	27.2	6.3	0.5	17.5	5.9	2.5	2.4	50.3
	100-130+	20.5	52.6	26.9	6.0	0.2	23.6	8.9	4.6	1.9	58.9

which the thickness of A horizon was 12 cm and that of B horizon 63 cm. The soil development under Scrub forest showed 26 cm thick A horizon and deeper (45 cm) B horizon. In contrast there were comparatively deeper B horizons in the soils developed on *Shorea robusta* and *Dalbergia sissoo* (160 cm and 120 cm respectively). The B1 and B2 horizons were marked by clay cutans in the soil profile of Ladpur block. The formation of thick B2 horizon on stable landforms is possible under relatively more intense soil forming processes.

Characteristics of the Soils : Physical and chemical characteristics of the soils are given in Table 2. The soils were generally moderately to strongly acidic. The variation in soil pH under different forest vegetation ranged from 5.0 to 6.8. In general the pH was higher in the upper horizons than in the lower ones. The soils formed under *Quercus leucotrichophora* (Sripur block) were more acidic than the soils under *Pinus roxburghii* (Ringalgarh block). The soils of Mahipur, Rajpur and Raipur blocks were less acidic because of their location at relatively lower altitudes and less organic matter. The soils under Scrub and *Dalbergia sissoo* (Dwara and Ladpur blocks) were moderately acidic.

The soil organic matter content was generally higher in different forest vegetation at high altitude as than in lower ones. It was generally medium to low with maximum accumulation in the surface horizon. It decreased with depth but without a definite trend. It was much higher in the surface horizon of soils developed under *Pinus roxburghii* and *Quercus leucotrichophora* at an altitude of 500 and 2,000 m respectively. The increase in organic matter content with increase in altitude is due to the addition of leaf litter annually and slow decomposition of organic residues under low temperature (Dimri *et al.*, 1997; Jha and Dimri, 1991).

The soils from Ladpur, Dwara, Raipur, Rajpur, Mahipur, Sripur and Ringalgarh blocks were silty loam to loam, silty loam, silty, silty loam to silty clay loam in texture respectively.

In the profile from Ladpur, the clay content increased from 11.4 in A1 horizon to 13.2 per cent in B2 horizon showing thereby the movement of clay from A to B horizon. The increase in the clay content of B horizon may also be due to *in-situ* weathering of minerals. In the case of Dwara block, there was decrease in clay content. The clay percentage increased from 18.4 in A1 horizon to 19.6 in B3 horizon in the soil profile of Raipur block, whereas the increase in the clay content in the soil profile of Rajpur block was from 18.2 per cent in the A1 horizon to 21.3 per cent in the B 3 horizon. The B1 horizon of soil profile of Mahipur block showed 24.7 per cent clay as compared to 21.6 per cent in A1 horizon. From the clay content of different horizon, it is quite evident that movement of clay from A to B horizon has taken place in all the profiles. However, illuviation of clay fractions was more pronounced in the profiles from Ladpur, Dwara, Mahipur and Ringalgarh block which appeared to be more developed than those from Raipur, Rajpur and Sripur blocks where the thickness of B horizon was less. Geis *et al.* (1970) also reported the accelerated movement of clay from A to B horizon under different forest vegetation.

Cation exchange capacity (CEC) of the soil of different profiles showed inconsistent trend (Table 2). Among the different forest vegetation, the soils under *Pinus roxburghii* (Ringalgarh), *Quercus leucotrichophora* (Sripur and Scrub (Dwara) showed comparatively higher CEC than the soils under *Shorea robusta* and *Dalbergia sissoo* (Raipur, Rajpur, Mahipur and Ladpur blocks). The higher CEC values of the soils may be due to higher organic matter and clay content. Although the clay content of the soils was relatively high, the cation exchange capacity was low. This is due to the nature of clay minerals present in the soils of moist deciduous forests, which are mostly kaolinite, illite and chlorite type. The CEC, in general, appeared to be on the higher side in A horizon as compared to horizons below.

Among the exchangeable cations, Ca^{2+} was dominant, followed by Mg^{2+}. Among the different types of vegetation, the content of exchangeable Ca^{2+} was maximum under *Quercus leucotrichophora* and minimum under *Dalbergia sissoo*. The lower exchangeable Ca^{2+} values were due to the leaching of the bases from the soils due to high rainfall resulting in low pH and coarse texture. The higher content of organic matter, exchangeable Ca^{2+}, nitrogen and water holding capacity in the natural Himalayan forests has also been reported by Puri and Gupta (1955) and Yadav (1963). The Ca^{2+} and Mg^{2+} increased in the sub-surface horizons in some of the profiles due to presence of limestone parent material. The base saturation was generally low in upper and more in lower horizons due to leaching of bases under the impact of rainfall.

In all the soil profiles, there was clay illuviation and the base saturation was more than 35 per cent. Due to clay illuviation and greater thickness of B horizon, soils from Ringalgarh, Sripur and Dwara blocks having *Pinus roxburghii, Quercus leucotrichophora* and Scrub vegetation appeared to be more developed than those from Ladpur (*Dalbergia sissoo*), Raipur, Rajpur and Mahipur (*Shorea robusta*) blocks respectively.

SUMMARY

Soil formation in relation to forest vegetation were studied in seven blocks of Raipur range of Mussoorie Forest Division, Uttaranchal (altitude 800 m to 2,000 m above msl). The physical and chemical attributes of the soils under different forest covers were related to various vegetational parameters. The results showed that organic matter content was generally higher in different forest vegetation at high attitudes than at lower ones. Cation exchange capacity of the soils of different profiles showed inconsistent trend. Illuviation of clay and sesquioxides had taken place in the B horizons of all the soils. Base saturation percentage in the surface horizons of all the profiles varied from 43.9 to 64.3, while the range in pH was from 5.5 to 6.8. As the clay illuviation was more pronounced in the profiles from Ringalgarh, Sripur and Dwara blocks, these soils appeared to be more developed than the soils of Ladpur, Raipur, Rajpur and Mahipur blocks.

मसूरी वन मण्डल (उत्तरांचल) में वन मृदाः वनस्पति सबंध

ए०के० रैना, एम०एन० झा व एस०सी० फरासी

साराशं

वन वनस्पतियों के सन्दर्भ में मृदा बनने का अध्ययन मसूरी वन मण्डल उत्तरांचल (माध्य समुद्रतल से ऊंचाई 800 मी से 2000 मी तक) के रायपुर परिक्षेत्र के सात भूखण्डों में किया गया । विभिन्न वन आवरणों के अधीन मिलने वाली मृदाओं की भौतिक और रासायनिक विशेषताओं को भिन्न-भिन्न वनस्पतिक परिमापों से सम्बन्द्ध किया गया । परिणामों ने दिखवाया कि भिन्न-भिन्न वन वनस्पतियों में कम ऊंचाइयों की अपेक्षा अधिक ऊंचाइयों पर जैव तत्व सामान्यतः अधिक

पाया जाता है । विभिन्न पार्श्वचित्रों की मृदाओं की घनायन विनिमय क्षमताओं ने अस्थिर प्रवृति प्रदर्शित की । सभी मृदाओं के बी या ख संस्तर में चिकनी मिट्टी और सस्किआक्साइडों का विनिक्षेपण हुआ है । सभी पार्श्वचित्रों में समाक्षार संतृप्ति प्रतिशत ऊपरी स्तर के संस्तरों में 43.9 से 64.3 तक रहा जबकि पी एच 5.5 से 6.8 तक रहा । चिकनी मिट्टी का विनिक्षेपण रिंगालगढ़, श्रीपुर और द्वारा खण्डों के पार्श्वचित्रों में अधिक मिला इसलिए इन खण्डों की मृदा लाडपुर, रायपुर और महिपुर खण्डों की मृदाओं की तुलना में अधिक विकसित प्रतीत होती है ।

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FIRST RECORD OF COCCINELLID BEETLES (COLEOPTERA : COCCINELLIDAE) ON POPLAR, *POPULUS DELTOIDES* FROM NORTH INDIA

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Introduction

Nearly 40 coleopteran species, in the form of borers and defoliators, are known to be associated with different species of Poplar in India, as documented by Beeson (1919, 1941), Mathur and Singh (1960), Rishi (1981), Sen-Sharma and Gupta (1981), Singh and Singh (1986) and Thakur (1981, 1999). No reference is however available regarding occurrence of coccinellid beetles, predaceous or phytophagous on Poplar. The present report of nine coccinellid beetles from Poplar nurseries in Tarai regions of Uttaranchal (formerly Uttar Pradesh) and Haryana constitutes first record of its kind.

The current work stemmed out of our regular survey conducted for collecting Poplar defoliator (*Clostera cupreata*) and its biological agents in Poplar nurseries and plantations under Central Tarai Forest Division, Haldwani (Uttaranchal), Yamuna Nagar Forest Division (Haryana) as well as in New Forest, Dehra Dun. Young saplings of Poplar were found to be moderately attacked by aphids from March to June, in almost all the Poplar nurseries visited especially Chichrauli (Yamuna Nagar) and Lal Kuan (Haldwani), suffering noticeable damage thereby. Presence of coccinellid beetles and their concomitant rise in relation to the prey population causing gradual decline in the population of latter intrigued our attention, with a view to their practical utility in future. *Coccinella septempunctata* and *Coccinella septempunctata* var. *divaricata* (now synonymised under previous species) were found to be predominantly active in attacking aphids, followed by *Menochilus sexmaculatus*, *Propylea japonica* and *Rodolia fumida*. Remaining species were seen occasionally on Poplar plants. Phytophagous species, *Epilachna vigintioctopunctata* was recorded for the first time on Poplar leaves.

Present record comprise coccinellid species described by Kapur (1950, 1972), Mulsant (1846, 1850, 1853, 1866) etc. A key for their separation has been prepared based on very prominent characters like those of spots or bands on pronotum and elytra. It will help forest entomologists for an easy identification. Necessary information including synonymies provided for each taxon may be of immense help in easy updating of the coccinellid material. The type specimens were deposited in Insect Reference Collection of Forest Entomology Division, F.R.I., Dehra Dun.

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Key for the separation of coccinellid beetles recorded on Poplar

1. Elytra with spots or bands; body smooth, glabrous...............................3
   - Elytra without spots or bands; body hairy or smooth...............................2

2. Body hairy; colour reddish brown to rose red; pronotum without spots.........i) *Rodolia fumida* Mulsant
   - Body smooth; colour yellowish brown; pronotum with two black spots...........ii) *Illeis cincta* (Fabricius)

3. Phytophagous form; pronotum with 7 black spots; each elytron with 14 black spots................................iii) *Epilachna vigintioctopunctata* (Fabricius)
   - Predaceous forms; other characters different...4

4. Body yellowish brown to fiery red; elytra with 7 black spots.......... iv) *Coccinella septempunctata* Linnaeus
   - Body yellow to yellowish brown; elytral characters different.............5

5. Pronotum with two transverse bands connected medially by a narrow constriction; each elytron with 2 zigzag bands and one sub-apical spot.......v) *Menochilus sexmaculatus* (Fabricius)
   - Characters on pronotum and elytra different..6

6. Elytra with black sutural band 7
   - Elytra without black sutural band...8

7. Pronotum with its major portion black; sutural band on elytron with three widely separated horizontal bands on each side... vi) *Propylea japonica* (Thunberg)
   - Pronotum as above; sutural band on elytra without horizontal bands .... vii) *Micraspis discolor* (Fabricius)

8. Body oblong, weakly convex; each elytron with 6 irregular spots............ viii) *Hippodamia variegata* (Goeze)
   - Body rounded, strongly convex; each elytron with two black oppositely placed L-shaped bands and one triangular apical spot......... ix) *Anegleis cardoni* (Weise)

1. ***Rodolia fumida* Mulsant**

Rodilia fumida Mulsant, 1850: 904.
Rodolia roseipennis Mulsant, 1850: 904.
Rodolia arethusa Mulsant, 1853: 254.
Rodolia testicolor Mulsant, 1853: 255.
Rodolia fumida Mulsant; Kapur, 1950: 1.

Diagnostic characters : Colour variable, rose red, reddish brown, brown to dark brown. Body pubescent, oval, slightly narrowed posteriorly, moderately convex. Length: 5.0 - 5.6 mm.

Type Locality : New Forest, Dehra Dun. 4. iv. 1997.

Host : Aphids. It is also used as an important bio-agent against margarodids on mango (Rasheed *et al.* 1986).

2. *Illeis cincta* (Fabricius)

Thea cincta (Fabricius); Bagal and Trehan, 1945:569.
Illeis (Illeis) cincta (Fabricius); Khnz., 1979:63.

Diagnostic characters : Colour yellowish brown. Pronotum with two rounded black spots. Elytra without any spot or band. Body smooth, oval, moderately convex. Length : 3.0-3.5 mm.

Type Locality : Research nursery, Lal Kuan, 19.ix.1997.

Host : Aphids. The larvae and adult of this species have also been recorded feeding on fungus (Dharpur *et al.*, 1990). Present collection from Poplar nursery during late rainy season when fungal attack is quite common, alludes its association with fungus on Poplar.

3. *Epilachna vigintioctopunctata* (Fabricius)

Coccinella 28-punctata Fabricius, 1775 : 84.
Coccinella sparsa Herbst, 1786 : 160.
Epilachna vigintioctopunctata Fabricius; Richards, 1983 : 17.
Epilachna sparsa (Herbst); Dieke, 1947.

Diagnostic characters : Colour yellowish brown. Pronotum with seven black spots. Each elytron with 14 black spots. Body smooth, oval, moderately convex.
Length : 5.0-5.5 mm.

Type Locality : Chuckpheri, Lal Kuan, 26.iv.1998.

Comments : The present species was recorded on Poplar leaves.

4. *Coccinella (Coccinellla) septempunctata* Linnaeus

Coccinella (Coccinellla) septempunctata Linnaeus, 1758:365.
Coccinella (Coccinellla) divaricata Olivier, 1808:1001.
Coccinella (Coccinellla) confusa Wiedemann, 1823:12.
Coccinella (Coccinellla) brucki Mulsant 1866:90.

Diagnostic characters : Colour yellowish brown to reddish brown. Pronotum black except antero-lateral regions yellowish brown to reddish brown. Elytra with 7 black spots including 1 sutural spot i.e. 3½ spots on each elytron. Body smooth, oval, moderately convex. Length : 4.0-5.0 mm.

Type Locality : Chuckpheri, Lal Kuan, 20.iii.1997. Research nursery, Lal Kuan, 19.iii.1997. Sanjay van (C.T.F.D.) Haldwani, 20.iii.1997. Pansara, Yamuna Nagar (Haryana), 5.v.1998. New Forest, Dehra Dun. 20.v.1998.

Host : Aphids

Comments : It was found in abundance predating actively on aphids in almost all the nurseries visited.

5. *Menochilus sexmaculatus* (Fabricius)

Coccinella sexmaculatus Fabricius, 1781:91.
Coccinella lingaensis Takizawa, 1917:221.

Diagnostic characters : Colour creamish, yellowish brown to reddish brown. Pronotum with black basal band connected by a short narrow constriction with a transverse oval black discal spot. Each elytron with two black zigzag bands and

one rounded sub apical spot. Body smooth, oval, and moderately convex.
Length : 2.8-4.5 mm.

Type Locality : Chuckpheri, Lal Kuan, 20.iii.1997. Pansara, Yamuna Nagar, (Haryana). 5.v.1998.

Host : Mostly aphids. It has also been found preying on aleyrodids, coccids, jassids, psyllids, sometimes eggs and young larvae of certain Lepidoptera and nymphs of tingiids and delphacids.

6. ***Propylea japonica*** **(Thunberg)**

Coccinella japonica (Thunberg), 1781:12.
Propylea conglobata Lewis, 1873:55.
Propylea japonica (Thunberg); Khnz., 1979:58.

Diagnostic characters : Colour yellowish brown. Pronotum with major portion black except narrow anterior and lateral margins. Each elytron with black sutural margin giving off three horizontal black bands much separated with external elytral border. Body oval, weakly convex, slightly narrowed towards apex, without hairs. Length : 3.9-4.0 mm.

Type Locality : Research nursery, Lal Kuan, 19.iii.1997 and 3.v 1999. Sanjay van (C.T.F.D.) Haldwani, 20.iii.1997. Chuckpheri, Lal Kuan, 26.iv.1998.

Host : Aphids

7. ***Micraspis discolor*** **(Fabricius)**

Coccinella discolor Fabricius, 1798:77.
Verania discolor (Fabricius); Mulsant, 1850:369.
Micraspis discolor (Fabricius); Khnz., 1979:73.

Diagnostic characters : Colour yellowish brown. Pronotum with major portion black except yellowish brown antero-lateral regions. Elytra with only black sutural band. Body smooth, oval, and moderately convex. Length : 4.0-4.2 mm.

Type Locality : Sanjay van (C.T.F.D.) Haldwani, 20.iii.1997. Research nursery, Lal Kuan, 4.v.1998.

Host : Aphids, It also preys on aleyrodids, psyllids and thrips.

8. ***Hippodamia (Adonia) variegata*** **(Goeze)**

Coccinella variegata Goeze, 1777:247.
Hippodamia (Adonia) variegata (Goeze); Mulsant, 1846:39.
Hippodamia (Adonia) variegata (Goeze); Korchefsky, 1932:346.
Hippodamia (Adonia) variegata (Goeze); Khnz., 1979:65.

Diagnostic characters : Colour yellowish brown. Pronotum black except with narrow anterior and lateral margins. Each elytron with 6 irregular black spots including one sutural spot. Body smooth, oblong, weakly convex. Length : 4.0-4.5 mm.

Type Locality : Research nursery, Lal Kuan, 19.iii.1997.

Host : Aphids

9. ***Anegleis cardoni*** **(Weise)**

Verania cardoni (Weise); 1892:19.
Caelophora cardoni (Weise); Graham, 1894:202.
Caelophora cardoni (Weise); Korschefsky, 1932:599.

Micraspis cardoni (Weise); Timberlake, 1943:28.

Micraspis cardoni (Weise); Kapur, 1972:316.

Anegleis cardoni (Weise); Khnz., 1979:64.

Diagnostic characters : Colour creamish. Pronotum creamish with one brown transverse spot united completely with posterior margin, slightly concave in middle; two more rounded spots a little above the median line. Each elytron with two black oppositely placed L-shaped bands and one small triangular spot at apical region. Body smooth, moderately convex. Length : 3.1-3.3. mm.

Type Locality : New Forest, Dehra Dun. 6.iii.1997.

Host : Aphids. Its prey also includes coccids and sometimes eggs of spider.

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SUMMARY

Association of nine coccinellid beetles with Poplar (*Populus deltoides*) was recorded first time from Poplar nurseries, in Tarai region of Uttaranchal and Haryana. These include eight predacious species viz. *Anegleis cardoni* (Weise), *Coccinella septempunctata* Linnaeus, *Hippodamia variegata* (Goeze), *Illeis cincta* (Fabricius), *Menochilus sexmaculatus* (Fabricius), *Micraspis discolor* (Fabricius), *Propylea japonica* (Thunberg) and *Rodolia fumida* Mulsant found feeding on aphids and other small insect preys infesting on Poplar foliage. Another coccinellis, *Epilachna vigintioctopunctata* (Fabricius) was found to be a phytophagous species feeding on Poplar foliage. A key for easy identification of the recorded species has been incorporated.

उत्तरी भारत से पोपलर, *पोपुलस डेल्टायडिस* से काक्सिनेलिड भृंग (कुंचुकपक्षाःकाक्सिनेलिडी) मिलने का प्रथम उल्लेख

मुख्तार अहमद, मुह० जमाल अहमद, शमा अफरोज व आर०के० मिश्र

साराशं

पोपलर (*पोपुलस डेल्टायडिस*) के साथ नौ काक्सिनेलिड भृंगों के साहचर्य का प्रथम उल्लेख उत्तरांचल और हरियाणा में लगाई पोपलर रोपणियों से प्राप्त हुआ। इन भृंगों में आठ हिंस्र जातियां अर्थात् *एनेग्लाइस कोडोनाई* (वाइजे), *काक्सिनेल्ला सेप्टेमपंक्टेटा* लि०, *हिप्पोडामिया वेरिगाटा* (गोयज़े), *इल्लेइस सिंक्टा* (फाब्रिसिउस), *मेनोकिलस सेक्समैमुलेटस* (फाब्रिसिउस), *माइक्रोस्पिस डिसकलर* (फाब्रिसिउस), *प्रोपायलिआ जैपोनिका* (थुन बर्ग) और *रोडोलिया फुमिडा* (मुल्सांर) पोपुलर की पत्तियों को पर्याक्रान्त करती द्रुयूकाओं और अन्य छोटे कीड़ों का भक्षण करते देखे गए। अन्य काक्सिनेलिड, *एपिलेक्ना विजिण्टिओक्टोपंक्टेरा* (फाब्रिसिउस) पर्णभक्षी निकला और पोपलर की पत्तियां खा रहा था। उल्लिखित जातियों की सरलता से पहचान कर लेने को एक कुंजी भी सम्मिलित कर दी गई है।

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NEEM OIL EXTRACTION AND USES

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Introduction

Since about two decades Neem has attracted the attention of chemists and biologists all over the world. This is on account of biological activities and multiple uses of oil and deoiled meal. Neem (*Azadirachta indica* A. Juss.), belonging to the family 'Meliaceae' is native to India, Pakistan, Indonesia, Thailand and Myanmar. It has been successfully introduced in Sudan, Zimbabwe, Guinea, Ghana, Cuba, Cameron, Sierra Leone, Malawi, Zambia, Tanzania, Zanzibar, Japan, tropical Australia etc. It is cultivated in most parts of India except at high altitudes and in cold regions and damp sites (Sidhu, 1995). It is a large evergreen tree, 12-18 m in height and 1.8-2.4 m in girth with a straight bole. The estimated data on the distribution of the trees and collection of seed for its valuable oil are presented in Table 1.

There are about 14 million Neem trees in India. With the introduction of fast growing exotic tree species like *Eucalyptus*, Poplar etc., required for industrial needs of the country, the preference for planting slow growing native trees has come down. But by virtue of multifarious uses and properties, Neem is still preferred to other native tree species as avenue tree (Sidhu, 1995).

Neem is an outstanding example of possessing maximum Non-wood Products. The Non-wood Products of Neem meet the basic needs of rural households like medicines, pesticides, mosquito repellents, fertilizers, diabetic food, soaps, lubricants, gums, tooth paste, and toothbrush sticks etc. The Non-wood Products of Neem have great utility in daily life and serve as anti-allergic, anti-dermatic, anti-feedant, anti-fungal, anti-inflammatory, anti-pyorrhoeic, anti-scabic, anti-viral, anti-tubercular, cardiac, diuretic, insecticidal, larvicidal, nematicidal, piscicidal, spermicidal, etc. (Rawat, 1995). Considerable amounts of synthetic pesticides are being used throughout the world to control heavy losses in food and other crops by various pest species during growth, harvest and storage. Many of the synthetic pesticides previously used for insect control have been banned or their use seriously curtailed due to their negative impact on health and environment. The discovery and use of safe botanical pesticides has become an essential requisite. As a result, several effective formulations have been prepared from Neem and their major constituents isolated in a pure state (Siddiqui *et al.*, 1996).

Table 1

Statewise distribution of Neem trees and the availability of seeds (Anon., 1985)

State	Number of trees	Estimated potential of seeds (MT) (1980)	Actual collection of seed (MT)
Tamil Nadu	2,470,000	57,000	15,500
Karnataka	767,581	18,804	3,706
Andhra Pradesh	634,855	11,500	3,128
West Bengal	265,000	2,339	615
Madhya Pradesh	714,187	17,060	368
Maharashtra	689,419	26,400	210
Orissa	—	1,103	200
Gujarat	617,632	75,000	139
Uttar Pradesh	7,740,393	249,242	—
Punjab	—	11,287	—
Rajasthan	—	32,000	—
Total	13,899,067	501,735 (414,633)	23,866 (23,617)

Neem Fruits

The ripening time of Neem fruits is from May to August. The fruit is recommended for urinary disease, piles, intestinal worms, leprosy, etc. The dry fruits are bruised in water and employed to treat cutaneous disease (Rawat, 1995). The fruit pulp is edible and is eaten by humans, birds and animals (Bohra *et al.*, 1999). It is used as tonic, anti-periodic, purgative and as anti-helmintic. On an average, the fruit consists of the following (Tewari, 1992) :

Skin	23.8%
Pulp	47.5%
Shell	18.6%
Kernel	10.1%

Neem Seeds

A Neem tree becomes fully productive in about 10 years time. A tree produces 30-50 kg of seeds every year. It yields not only Neem oil and cake but also an important chemical, Azadirachtin, which is a very useful product due to its bioactivity and forms a part of many commercial product formulations. The fruits fallen down or beaten down, are swept together, depulped by rubbing in water and dried. The seed on an average comprises 44.7% kernel and 55.3% shell (Tewari, 1992).

Quantity of Neem seeds exported during the period 1994-95 to 1999-2000, quantity of Neem seeds processed and quantity of oil produced and exported

Table 2

Export of Neem seeds (Anon., 1995-2000)

Year	Quantity (MT)	Value (Rs.)	Unit value (Rs.)
1994-95	1373	31,15,685	2269
1995-96	8	28,024	3503
1996-97	-	-	-
1997-98	72	5,13,732	7135
1998-99	9	33,577	3731
1999-2000	-		-

Table 3

Neem seed processed, production and export of oil (Anon., 1995-2000)

Year	Neem seeds processed (MT)	Production of oil (MT)	Export of oil		
			Qty. (MT)	Value (Rs.)	Unit value (Rs./MT)
1992-93	-	-	89	12,46,699	14,007
1993-94	-	-	135	21,16,866	15,680
1994-95	80,346	9378	75	7,47,560	9,967
1995-96	78,375	8215	45	5,92,299	13,162
1996-97	77,914	8031	435	1,04,43,668	24,008
1997-98	49,003	5448	293	70,02,927	23,901
1998-99	30,006	3319	85	21,51,787	25,315
1999-2000	29,610	3001	211	66,84,494	31,680

during the period 1992-93 to 1999-2000 are given in Table 2 and 3 respectively.

Neem Oil

Storing of the seeds for three months is necessary for optimum yield of oil. Neem oil is the major Non-wood Product of Neem tree. The kernels yield a greenish yellow to brown acrid bitter fixed oil (40-48.9%), known 'Oil of Margosa', having a strong disagreeable garlic like odour. The yield is equivalent to 23.5% of the whole seed. The kernels from Sri Lanka have been reported to yield 59.25% of oil which is equivalent to 31% of the whole seed (Anon., 1985). The kernels crushed in 'Ghani' or expeller, give 30 to 40 per cent oil. The local oil presses yield three per cent less oil than the expellers. The residual oil may be recovered by solvent extraction method. The oil is sometimes extracted by boiling the crushed kernels with water. The oil should be stored in well closed containers (Tewari, 1992).

Physico-chemical constants of the oil are as follows (Lakshmikantan, 1978) :

Colour	Greenish brown
Odour	Garlic, repulsive
Specific gravity (30°C)	0.9087-0.9189
Refractive index (40°C)	1.4617-1.4627
Titer	35-36°
Saponification value	193-204
Iodine value	68.0-75.8
Unsaponifiable matter	0.8-2.4%

Fatty acid composition of the oil is given below (Lakshmikantan, 1978) :

Fatty Acid	Percentage
Myristic	0.2 - 2.6
Palmitic	13.6 - 16.2
Stearic	14.4 - 24.1
Oleic	49.1 - 61.9
Linoleic	2.3 - 15.8
Arachidic	0.8 - 3.4

The refined and purified oil has the following characteristics (Anon., 1985) :

Specific gravity (30°C)	0.9087
Refractive index (30°C)	1.4612
Iodine value (Wij's)	66.4
Saponification value	290.9
Unsaponifiable matter	0.8%

Fatty acid composition of the refined oil is as follows (Anon., 1985) :

Fatty Acid	Percentage
Myristic	0.2
Palmitic	16.2
Stearic	14.6
Arachidic	3.4
Oleic	56.6
Linoleic	9.0

Uses of Oil

Neem oil, known as 'Oil of Margosa' is perhaps the most commercially important raw material for the manufacture of many value added products like soaps, cosmetics, lubricants, medicines, pesticides etc. It can act as a substitute of edible oil also. Considerable quantities of oil are employed in cosmetic preparations, such as cream, hair lotions and medicated soaps etc. It can also be mixed with other oils for making soaps. The major problem in using Neem oil in soap manufacture is its objectionable odour. The unattractive brown colour and smell of soap made from Neem oil, could be considerablv reduced by second boiling and by salting out the soap. Godrej Soaps Limited have developed a process to convert Neem oil into high quality light coloured, odourless soap, having no bitter taste. The oil can be used for the production of olein and stearin and high melting stearin after hydrogenation. The oil is also employed is disinfectants and emulsifying agents for insecticides. It has a potential to be converted into Polyol to substitute similar petroleum product (poly propylene glycol used as a rocket propellant fuel). It can also be used in textile and rubber industries. Regular application of hair oil, containing oil of Margosa is reported to prevent baldness and greying of hair. The refined oil is stable and does not become rancid on storage (Anon., 1985).

Medicinal properties of the oil are attributed to the presence of bitter principles and odorous compounds. These bitter principles are pharmaceutically important. The alcoholic extract, after removal of the bitter principles, can be used as an agrochemical for the preparation of water based pesticidal spray for common agricultural and horticultural pests. Neem oil generally has a long period of effectiveness when used in grain storage (Sidhu, 1995). It is also a useful remedy in some chronic skin diseases and ulcers. It is commonly used in external application for rheumatism, leprosy and sprain. Intrauterine medication of oil controls different types of metritis. The warm oil relieves ear trouble. The oil also cures dental and gum troubles. A few drops of oil taken in betel-leaf provide relief in asthma. The oil is reported to have anti-fertility properties also. It possesses antiseptic and antifungal activity and is found to be active against both gram-positive and gram-negative organisms. Scientists at the US Department of Agriculture Research Services, Beltsville, Maryland have found that a light coating of Neem oil cuts in half the loss of storage apples to fungal rots, a major problem in the apple industry (Aggarwal and Dhawan, 1995).

As contraceptive : Indians have been using Neem as an infertility agent. The WHO task force has identified Neem among the 225 plants used as anti-fertility agents. Tests carried out at the Netherlands have proved Neem oil as a non-toxic, post-coital contraceptive for preventing the implantation of the egg. Neem oil has proved its potential to immobilize and kill spermatozoa and interfered with female hormones to cause infertility. Given orally or intra-vaginally, Neem oil terminates pregnancy in rats. Thus having multifarious medicinal properties, Neem "A Wonder Tree" is found to be a potent contraceptive. Its efficacy as anti-fertility agent has been tested on rats and bonnet monkeys. With a little more research on Neem oil, chemical aspects, derivatives and mechanisms of action, it will be proven as a wonder drug which can be patented for human being as an alternate approach to vasectomy and Intra Uterine Contraceptive Device (IUCD). The tree will prove to be a major source of income/revenue capturing the market in India and abroad (Kumar and Jattan, 1995). Neem oil being spermicidal against human spermatozoa, both *in-vivo* as well as *in-vitro*, has anti-implantation effect on pre- or post-mating, or pre- or post-implantation, intravaginal application, and exhibit anti-ovulatory activity in both the reflex and spontaneous ovulators. Its oral administration causes male sterility activity with no interference in spermatogenesis. In females both oral and intra-vaginal oil application causes anti-fertility effects due the foetal resorption. Neem oil contraception is reversible and the fertility can be restored in around 30 days on cessation of the treatment. A steam volatile, odorous fraction of the oil, coded as Nim - 76, is considered responsible for its spermatocidal effect. A commercial preparation 'Sensal' containing Neem oil (98% W/V), camphor (1.5% W/V), 'Ketki', citronella and lemongrass (0.5% W/V) has been developed as a safe, reliable, intravaginal, pre-coital, spermicidal contraceptive, having also antiseptic and medicinal properties (Randhawa and Parmar, 1993).

The Indian scientists from the Defence Institute of Physiology and Allied Sciences (DIPAS) have applied for patents on chemicals isolated from the Neem oil which have proved to be promising contraceptive agents which are DK-1 and DNM-5. A third active agent coded as DNM-7 acts as an abortifacient causing abortion if administered orally after implantation has already occurred (Aggarwal and Dhawan, 1995).

Anti-Diabetic Products : Five to ten drops of the Neem oil when taken daily act as antihyper glycemic and blood purifier. To enable this, the oil is formulated in gelatine capsules, 'Nimbola' by M/s Kee Pharma, New Delhi. It is an oral treatment for diabetes control and is stated to be devoid of any side effects (Randhawa and Parmar, 1993).

Neem Cake : Neem cake is the major by product of the Neem oil extraction industry. It contains more sulphur (1.07-1.30%) than any other cake. It is an excellent fertilizer. It not only acts as an organic nitrogen manure but also nitrification inhibitor (Nitrogen regulator). Research at International Rice Research Institute in Philippines indicates that by mixing Neem seed with urea and incorporating it into soil, nitrification is inhibited, thus reducing nitrogen loss through leaching and denitrification. This property helps in efficient use of nitrogenous fertilizers. The average nutrient content of Neem cake in comparison with other non- edible oil cakes is given below (Rawat, 1995) :

Name	Composition		
Non-edible Oil Cake	N	P_2O_5	K_5O
Castor cake	4.3	1.8	1.3
Mahua cake	2.5	0.8	1.8
Neem cake	5.2	1.0	1.4
Sunflower cake	4.9	1.4	1.2

The Neem cake has its worth approximately Rs. 22 crores if it is expeller cake and Rs. 14 crores if it is deoiled cake. Oil cakes have been used to control nematodes in tomato, potato and radish. Its extract or cake has also been used as insecticide, antifeedant, fertilizer, microbicide protectant of wheat seeds against attack of *Tribolium granarium* (Anon., 1985). The residue left after the oil has been removed, varies widely in composition. However, the broad ranges in composition area :

Composition		Percentage
Crude protein	:	13 - 35
Carbohydrate	:	26 - 50
Crude fibre	:	8 - 26
Fat	:	2 - 13
Ash	:	5 - 18
Acid insoluble ash	:	1 - 17

It is widely used in India to fertilize cash crops, particularly sugarcane and vegetables. Plowed into the soil, it protects plants from roots nematodes and white ants, probably due to its content of the residual limonoids. Surprisingly Neem cake sometimes seems to make soil more fertile than calculations predict (Anon., 1993).

The cake is used as a cattle feed. In Andhra Pradesh it is given as a regular feed to cattle. Though bitter in taste, cattle use to get accustomed to it on regular feeding. The fresh cake smells bad but the odour is lost on sun drying. The animal fed on this cake were found healthy, and their yield of milk has been found good. The shelf life is good as it is not easily spoiled on storage nor it is attacked by fungi. The processed cake can be employed as a good poultry feed. Since the cake is bitter, it also have vermicidal activity (Anon., 1985).

The residual bitter substances and odorous principles present in the defatted meal from decorticated kernels can be removed by extraction with ethanol or methanol. The mean on further processing and drying is obtained as a light straw coloured granular powder of agreeable taste and flavour. It is suitable as feed for cattle and poultry. The cake is rich in most of the essential amino acids, except valine and tryptophan which are in negligible quantities. Analysis of processed meal gave the following values (Tewari, 1992) :

Moisture	10.7%
Nitrogen	10.1%
Protein	63.0%
Carbohydrates	10.4%
Other organic matter	8.6%
Ash	7.4%
P_2O_5	4.9%
Iron	0.2%

Amino Acid	Percentage
1	2
Glycine	9.4
Aspartic acid	6.8
Alanine	5.3
Glutamic acid	11.8
Serine	7.6
Threonine	5.3
Valine - methonine	4.5
Nor-leucine-leucine	
Isoleucine	8.0
Arginine	6.3
Histidine	3.4
Lysine	3.9
Proline	5.9
Tyrosine	3.4
Phenylalanine-tryptophan	5.3
Cystine	3.1
Glutamine	1.6
and two unidentified ones	3.9, 4.6

The alcohol - extracted cake is a better nitrogenous manure than unextracted cake and by proper processing, manurial value may be increased. Urea coated with an extracted obtained from the oil regulates the rate of nitrification and increases the yield of grain straw of wheat. The pulp water, obtained during the depulping of fresh or dry fruits, can be used for manuring and for composting, and increasing crop yields. The pulp water contains : nitrogen : 1.2 and phosphoric acid, 0.27%.

In combination with nemagone, the cake gives better results than either of them alone. It reduces the occurrence of nematodes in wheat and increases the yield considerably. When applied to sugarcane, potato, cotton and paddy, there is a similar increase in yield. It protects crops from termites.

SUMMARY

In this paper distribution of Neem trees, potential of seeds, export of Neem seeds, quantity of Neem seeds processed, production and export of Neem seed oil, properties and uses of oil and deoiled meal have been given.

नीम का तेल निष्कर्षण और उसके उपयोग

पी०पी० जैन, रवीन्द्र सिंह व शालिनी भडुंला

सारांश

इस अभिपत्र में नीम वृक्षों का वितरण, बीजों की शक्तिमत्ता, बीजों का निर्यात, विधायित बीजों की मात्रा, नीम बीज तेल का उत्पादन और निर्यात, तेल की विशेषताएं और उपयोग और तेल निकाली खली की विशेषताएं बताई गई हैं ।

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GROWTH RESPONSE OF *DALBERGIA SISSOO* TO AM AND *RHIZOBIUM* INOCULATIONS AND FERTILIZATION IN NURSERY

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Introduction

In the plantation drive in the northern plains, *Dalbergia sissoo* Roxb. is one of the preferred species both for commercial and Agroforestry or Social forestry plantations. Growth impact studies on mycorrhization and fertilization of some forestry species have shown a positive response of host species in nurseries. (Mehrotra *et al.*, 1999; Khan and Uniyal, 1999; Kormanik *et al.*, 1982, Thapar and Uniyal, 1996). Keeping in view the importance of *D. sissoo* and AM attributes to mycotrophic species, a nursery experiment was set up to study the impact of AM and *Rhizobium* inoculations alone and in combination with fertilizers on its growth.

Material and Methods

Dalbergia sissoo seeds were sown in polypots of size 20 x 9 cm filled with unsterilized potting mixture with 2:1 soil-sand ratio and 2 per cent FYM. Prior to filling of the pots, fertilizer doses were mixed in the potting mixture of respective treatments. In all, there were 10 treatments with 3 replicates, each replicate with 10 seedlings. Treatments comprise : control (without any treatment), NPK full dose (containing urea @ 25 kg N/ha, superphosphate @ 100 kg P_2O_5/ha and muraite of potash @ 25 kg K_2O/ha), NPK half dose, NPK one-fourth dose, inoculated with *Rhizobium*, inoculated with AM (*Glomus mosseae* and *G. geosporum*), inoculated with AM and *Rhizobium*, inoculated with AM and *Rhizobium* and fertilized with full dose of NPK, inoculated with AM and *Rhizobium* and fertilized with half dose of NPK and inoculated with AM and *Rhizobium* and fertilized with one-fourth dose of NPK. 200 g of AM inoculum comprising of sand, infected root bits, mycelium and spores was applied as layer at 8-10 cm depth of polypot at the time of sowing of *D. sissoo* seeds. An equal amount of sand was used as layer in uninoculated (control) polypots in place of AM inoculum. *Rhizobium* inoculum was applied @ 10 ml of broth culture per seedling after one month of seed germination. The experiment was concluded after 11 months. Standard methods were followed for staining (Phillips and Hayman, 1970) and for quantification of AM infection in roots (Giovanetti and Mosse, 1980).

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The analysis is based on mean values of response of the seedling for each replicate. The model used for analysis is :

$$Y_{ij} = \mu + t_i + \varepsilon_{ij}$$

Where

Y_{ij} is response of seedling receiving ith treatment and Jth replication,
μ is general mean,
t_i is the effect of ith treatment and
ε_{ij} is error term distributed normally with mean O and constant variance.

For better insight, some non-orthogonal contrasts are also evaluated.

Results and Discussion

The results are presented in the Tables 1 and 2. Result of Analysis of Variance (ANOVA) show that all the growth parameters including shoot height, collar diameter, root and shoot dry weight and total biomass are significant at the level of 5%. The mean values of different parameters presented in Table 1 show minimum value for control seedlings. The maximum value is for treatment with full dose of NPK alone which is statistically at par with seedlings inoculated with AM alone. These two treatments differ significantly from control (Table 2). Also, they do not differ significantly and thus effect-wise they are same i.e. the difference in value of the treatments is only a random fluctuation. Data presented in Table 2 also show that seedlings inoculated with *Rhizobium* alone and in combination with AM have similar values as that of control and AM alone respectively. Results of contrast analysis are presented in Table 2.

Table 1

Mean values of growth parameters against different treatments

Treatments	Parameter				
	Collar Dia. (mm)	Shoot Ht. (mm)	Dry Root Wt. (g)	Dry Shoot Wt. (g)	Total Biomass (g)
Control	3.79	26.95	1.48	1.65	3.13
NPK (Full)	4.44	39.67	3.90	3.74	7.64
NPK (Half)	3.77	31.30	2.51	2.57	5.07
NPK (One-fourth)	4.81	31.53	2.43	2.71	5.14
Rhizobium	3.96	28.79	1.65	1.87	3.52
AM	5.02	37.06	3.28	3.06	6.33
AM + *Rhizobium*	4.82	35.94	3.19	3.14	6.33
AM + *Rhizobium* + NPK (Full)	3.96	30.35	2.04	2.05	4.09
AM + *Rhizobium* + NPK (Half)	4.38	29.06	2.27	2.17	4.44
AM + *Rhizobium* + NPK (One-fourth)	4.42	35.45	2.00	2.81	4.80
CD (0.05)	0.62	06.82	0.80	0.99	1.64

Table 2

Mean sum of square of different contrasts

Contrast	Collar Dia. (mm)	Shoot Ht. (cm)	Dry Root Wt. (g)	Dry Shoot Wt. (g)	Total Biomass (g)
Control vs. NPK (Full Dose)	0.42*	161.79*	5.86*	4.37*	20.34*
Control vs. AM	1.51*	102.21*	3.24*	2.00*	10.24*
NPK (Full Dose) vs. AM	0.34*	6.81	0.38	0.46	1.72
Within NPK (All three doses)	0.56*	45.45*	1.37*	0.81	4.29*
Within AM + Rhi. + NPK (All three combinations)	0.13	22.84	0.04	0.33	0.31

*reflects significance at 5%.

Results within three treatments of NPK fertilizer doses differ significantly in all parameters except shoot dry weight. The comparison of all three combinations of AM, *Rhizobium* in combination with and three different doses of fertilizer is non-significant which shows that performance-wise all the three combinations of fertilizer doses with AM and *Rhizobium* are statistically same.

Overall analysis of the results show a significant response of AM inoculations against indigenous population of AM fungi (Control). Further, an increase in total biomass of 144 per cent and 102 per cent is achieved over control with NPK full dose and AM inoculations alone, thereby clearly indicating that AM inoculation with an efficient fungus can reduce the dependency of *D. sissoo* on fertilization.

SUMMARY

Results of a nursery experiment are presented on the impact of AM and *Rhizobium* inoculations alone and in combination with different doses of fertilizers for all the growth parameters including shoot height, collar diameter, root and shoot weight and total biomass. Maximum value for all the parameters was recorded when full dose of fertilizer (NPK) was applied and an equally significant response was recorded with AM inoculations.

रोपणी में आर्बुस्कुलर कवकमूलता और *राइजोबियम* टीका लगाने तथा उर्वरीकरण से *डलबर्गिया सिस्सु* में होने वाला वृद्धि प्रतिचार

एस०एन० खान, कमला उनियाल व राजीव पाण्डेय

सारांश

यहां पर आर्बुस्कुलर कवकमूलता और *राइजोबियम* का अकेले और उर्वरकों की भिन्न-भिन्न मात्राओं के साथ संयुक्त करके टीका लगाने के सभी वृद्धि परिमापों पर, जिनमें प्ररोह की ऊंचाई, मूलसंधि पर व्यास, जड़ और प्ररोह का भार और कुल जैवपुंज सम्मिलित हैं, पड़ते प्रभाव ज्ञात करने के लिए किए गए रोपणी संपरीक्षण के परिणामों को प्रस्तुत किया गया

है । सभी परिमापों की अधिकतम अर्हा उस समय मिलती उल्लिखित हुई जब उर्वरक (नाइट्रोजन, फास्फोरस, पोटाशियम) की पूरी मात्रा दी गई और उसके साथ आर्बुस्कुलर कवकमूलता का टीका लगाए जाने से उतनी ही सार्थक प्रतिचार होता उल्लिखित हुआ ।

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HOSTS AND THE PATHOGEN - SPECIES COMBINATIONS OF THE GENUS *PYTHIUM* IN INDIA

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Introduction

The Genus *Pythium* Pringsheim is an obligate saprophyte and a facultative parasite. The species of *Pythium* inhabit various types of soil and also occur in water. Besides infecting many economically important medicinal and forest plants in nurseries, *Pythium* also causes a number of destructive diseases like Seed-rot, Damping-off of seedlings, Root-rot and also Soft-rot of fleshy fruits, etc. belonging to many plant species. The seeds and seedlings are the worst enemies of this fungal genus which causes considerable losses to them both at pre- and post-emergence stages. And, therefore, the fungus captivated the attention of mycologists and plant pathologists of all over the world. Currently we know about 120 species of *Pythium* from all over the world. Despite, varied climatic and edaphic conditions, India is known to have record of only 40 species of this genus. Most of the known species are recovered by the plant pathologists from different hosts. Information about the taxonomy, host and their families, etc. are scattered and far apart in Indian literature. One of the authors of this short communication (JKM) while consolidating the taxonomic information regarding this genus in India (Misra, 1998) strongly felt the need to have checklists of *Pythium* species, the diseases they cause, and the host and their families, etc arranged in such a way so as to facilitate the workers in locating any of these combinations. This is perhaps the second brief but update consolidation of information on *Pythium* after the one by Rangaswami (1961).

Diseases

Pre- and post-emergence Damping-off, Stem rot, Root rot, Foot rot, Stalk rot, Fruit rot, Rhizome rot, Blossom-end rot, Collar rot, Cottony leak, Curd rot, Head rot, Tuber rot, Pod rot, *Pythium* die back, *Pythium* rot, *Pythium* leaf blight, *Pythium* leaf rot, Lethal yellowing, Seedling blight, Wilt disease in association with other fungi, Mycoses in fresh water fish.

Checklist 1

Hosts and Pythium species

Pythium species	Associated hosts
1	2
P. acanthophoron, P. aphanidermatum, P. graminicola, P. acanthophoron, P. debaryanum,	*Gossypium sativum*-cotton seedlings
P. aphanidermatum, P. aquatile, P. debaryanum, P. inflatum,	*Lycopersicum esculentum*
P. aphanidermatum, P. cucurbitacearum	*Trichosanthes dioca*
P. aphanidermatum, P. debaryanum, P. middletonii, P. aphanidermatum, P. debaryanum, P. middletonii	*B. oleraceae* var. *capitata*
P. aphanidermatum, P. debaryanum, P. myriotylum	*Arachis hypogaea*
P. aphanidermatum, P. debaryanum, P. myriotylum	*Nicotiana tabacum*
P. aphanidermatum, P. debaryanum	*Capsicum annuum*
P. aphanidermatum, P. deliense	*Abelmoschus esculentus*
P. aphanidermatum, P. graminicola	*Zea mays*
P. aphanidermatum, P. hydonosporum, P. ultimum var. ultimum	*Solanum tuberosum*
P. aphanidermatum, P. indigoferae	*Cucumis sativus*
P. aphanidermatum, P. middletonii, P. oedochilum	*B. oleraceae* var. *botrytis*
P. aphanidermatum, P. middletonii	*Lab-lab purpureus*
P. aphanidermatum, P. middleonii	*Raphanus sativus*
P. aphanidermatum, P. myriotylum, P. ultimum var. *ultimum*	*Leucaena leucocephala*
P. aphanidermatum, P. myriotylum	*Curcuma longa*
P. aphanidermatum, P. paroecandrum	*Phaseolus vulgaris*
P. aphanidermatum, P. spinosum	*Costus speciosus*
P. aphanidermatum, P. spinosum	*Hyoscyamum muticus*
P. aphanidermatum, P. ultimum var. *ultimum*	*Beeta vulgaris*
P. aphanidermatum, P. vexans	*Elettaria cardamomum*
P. aphanidermatum	*Abelmoschus* sp.
P. aphanidermatum	*Alium cepa*
P. aphanidermatum	*Amaranthus gangeticus*
P. aphanidermatum	*Amaranthus tricolor* var. *gangeticus*
P. aphanidermatum	*Atropa belladona*
P. aphanidermatum	*B. campestris* var. *toria*
P. aphanidermatum	*B. juncea*

Contd...

1	2
P. aphanidermatum	*B. oleraceae* var. *caulorapa*
P. aphanidermatum	*Balariane* sp.
P. aphanidermatum	*Belladona* sp.
P. aphanidermatum	*Cajanus cajan*
P. aphanidermatum	*Capsicum indicum*
P. aphanidermatum	*Carica papaya*
P. aphanidermatum	*Carthamus tinctorius*
P. aphanidermatum	*Catharanthus roseus*
P. aphanidermatum	*Citrullus fistulosus*
P. aphanidermatum	*Cocos nucifera*
P. aphanidermatum	*Colocynthus citrullus*
P. aphanidermatum	*Costus* sp.
P. aphanidermatum	*Crotolaria juncea*
P. aphanidermatum	*Cucumis melo*
P. aphanidermatum	*Cymbopogon martinii*
P. aphanidermatum	*Cymbopogon winterianus*
P. aphanidermatum	*Eleusine coracana*
P. aphanidermatum	*Hardwickia binata*
P. aphanidermatum	*Helianthus annuus*
P. aphanidermatum	*Heterodera avenae* (Nematode)
P. aphanidermatum	*Kalanchoe mortagei*
P. aphanidermatum	*Lactuca sativa*
P. aphanidermatum	*Lagenaria leucantha*
P. aphanidermatum	*Lagenaria siceraria*
P. aphanidermatum	*Lagenaria* sp.
P. aphanidermatum	*Lagenaria vulgaris*
P. aphanidermatum	*Linum grandiflorum*
P. aphanidermatum	*Luffa acutangula*
P. aphanidermatum	*Luffa aegyptica*
P. aphanidermatum	*Luffa cylindrica*
P. aphanidermatum	*Momordia cochinchinensis*
P. aphanidermatum	*Olpidiopsis indica* (fungus)
P. aphanidermatum	*Opuntia dillenti*
P. aphanidermatum	*Papaver* sp.
P. aphanidermatum	*Pennisetum americanum*
P. aphanidermatum	*Pennisetum typhoides*
P. aphanidermatum	*Raphanus sativus* var. *caudalus*
P. aphanidermatum	*Sesbania aculeata*

Contd...

1	2
P. aphanidermatum	*Solanum khasianum*
P. aphanidermatum	*Solanum laciniatum*
P. aphanidermatum	*Solanum melongena*
P. aphanidermatum	*Talinum triangulare*
P. aphanidermatum	*Trichosanthes anguina*
P. aphanidermatum	*V. sinensis*
P. carolinianum, P. catenultum	*Spirogyra* sp.
P. debaryanum, P. graminicola, P. catenulatum	*Saccharum officinarum*
P. debaryanum, P. monospermum	*Lepidium sativum*
P. debaryanum	*Gilia* sp.
P. debaryanum	*Clarkia* sp.
P. debaryanum	*Lens culineris*
P. debaryanum	*Malus* sp.
P. debaryanum	*Phaseolus radiatus*
P. debaryanum	*Spinacea oleraceae*
P. debaryanum	*V. radiata*
P. debaryanum	*Vigna unguiculata*
P. debaryanum	*Vitis vinifera*
P. deliense, P. echinulatum, P. graminicola, P. rostratum, P. deliense, P. myriotylum, P. spinosum	*Eucalyptus grandis*
P. deliense, P. myriotylum, P. vexans	*Eucalyptus tereticornis*
P. deliense	*Capsicum* spp.
P. deliense	*Cucumis utilissimus*
P. deliense	*Saponaria* sp.
P. deliense	*Tephrosia vogelii*
P. graminicola, Pythium sp.	*Oryza sativa*
P. graminicola	*Avena sativa*
P. graminicola	*Hordeum vulgare*
P. graminicola	*Sorghum vulgare*
P. graminicola	*Vicia faba*
P. indigoferae	*Indigofera arrecta*
P. aphanidermatum	*Ipomoea pulchella*
P. inflatum	*Oryza* sp.
P. intermedium	*C. eleusinoides*
P. intermedium	*C. papyrus*
P. intermedium	*Cyperus alternifolius*
P. intermedium	*Oroxylum indicum*
P. irregulare	*Coriandrum sativum*

Contd...

1	2
P. middletonii, P. spinosum, P. undulatum	*Brassica campestris*
P. middletonii	*Dolichos lablab*
P. middletonii	*Lagerstroemia* sp.
P. monospermum, P. myriotylum, P. ultimum var. *ultimum, P. vexans*	*Zingiber officinale*
P. monospermum	*Ricinus communis*
P. myriotylum	*Albizia falcatasia*
P. myriotylum	*Amaranthus* sp.
P. myriotylum	*Cyamopsis tetragonoloba*
P. myriotylum	*Eucalyptus tessellaris*
P. oligandrum, P. vexans, P. polytylum, P. ultimum var. *ultimum, P. vexans*	*Piper betle*
P. spinosum, P. torulosum, P. ultimum var. *ultimum*	*Triticum aestivum*
P. spinosum	*Dioscorea composita*
P. splendens	*Pelargonium graveolens*
P. splendens	*Zingiber* sp.
P. ultimum var. *ultimum, P. vexans*	*Pyrus malus*
P. ultimum var. *ultimum*	*Linum usitatissimum*
P. ultimum var. *ultimum*	*Cicer arietinum*
P. ultimum var. *ultimum*	*Pisum sativum*
P. undulatum	*Carassius auratus*
P. vexans	*Aframomum melegueta*
P. vexans	*Cinchona ledgeriana*
P. vexans	*Cinchona officinalis*
P. vexans	*Cinchona* sp.
P. vexans	*Cinchona succirubra*
P. vexans	*Pelargonium* sp.
P. vexans	*Piper longum*

Checklist 2

Hosts and Pythium species

Hosts	Species
1	2
Abelmoschus esculentus	*P. aphanidermatum, P. deliense*
Abelmoschus sp.	*P. aphanidermatum*
Albizia falcatasia	*P. myriotylum*

Contd...

1	2
Allium cepa	*P. aphanidermatum*
Amaranthus gangeticus	*P. aphanidermatum*
Amaranthus sp.	*P. myriotylum*
Amaranthus tricolor var. *gangeticus*	*P. aphanidermatum*
Arachis hypogaea	*P. aphanidermatum, P. debaryanum, P. myriotylum*
Aframomum melegueta	*P. vexans*
Atropa belladona	*P. aphanidermatum*
Avena sativa	*P. graminicola*
Balariane sp.	*P. aphanidermatum*
Beeta vulgaris	*P. aphanidermatum, P. ultimum* var. *ultimum*
Belladona sp.	*P. aphanidermatum*
Brassica campestris	*P. middletonii, P. spinosum, P. undulatum*
B. campestris var. *toria*	*P. aphanidermatum*
B. oleraceae var. *capitata*	*P. aphanidermatum, P. debaryanum, P. middletonii*
B. oleraceae var. *caulorapa*	*P. aphanidermatum*
B. juncea	*P. aphanidermatum*
B. oleraceae var. *botrytis*	*P. aphanidermatum, P. middletonii, P. oedochilum*
Cajanus cajan	*P. aphanidermatum*
Capsicum annuum	*P. aphanidermatum, P. debaryanum*
Capsicum indicum	*P. aphanidermatum*
Capsicum spp.	*P. deliense*
Carassius auratus	*P. undulatum*
Carica papaya	*P. aphanidermatum*
Carthamus tinctorius	*P. aphanidermatum*
Catharanthus roseus	*P. aphanidermatum*
Cicer arietinum	*P. ultimum* var. *ultimum*
Cinchona ledgeriana	*P. vexans*
Cinchona officinalis	*P. vexans*
Cinchona sp.	*P. vexans*
Cinchona succirubra	*P. vexans*
Citrullus fistulosus	*P. aphanidermatum*
Clarkia sp.	*P. debaryanum*
Cocos nucifera	*P. aphanidermatum*
Colocynthus citrullus	*P. aphanidermatum*
Coriandrum sativum	*P. irregulare*
Costus sp.	*P. aphanidermatum*
Costus speciosus	*P. aphanidermatum, P. spinosum*
Crotolaria juncea	*P. aphanidermatum*
Cucumis melo	*P. aphanidermatum*
Cucumis sativus	*P. aphanidermatum, P. indigoferae*
Cucumis utilissimus	*P. deliense*
Curcuma longa	*P. aphanidermatum, P. myriotylum*
Cyamopsis tetragonoloba	*P. myriotylum*
Cymbopogon martinii	*P. aphanidermatum*
Cymbopogon winterianus	*P. aphanidermatum*
Cyperus alternifolius	*P. intermedium*

Contd...

1	2
C. eleusinoides	*P. intermedium*
C. papyrus	*P. intermedium*
Dioscorea composita	*P. spinosum*
Dolichos lablab	*P. middletonii*
Elettaria cardamomum	*P. aphanidermatum, P. vexans*
Eleusine coracana	*P. aphanidermatum*
Eucalyptus grandis	*P. deliense, P. myriotylum, P. spinosum*
Eucalyptus tereticornis	*P. deliense, P. myriotylum, P. vexans*
Eucalyptus tessellaris	*P. myriotylum*
Gilia sp.	*P. debaryanum,*
Gossypium sativum-cotton seedlings	*P. acanthophoron, P. debaryanum*
Hardwickia binata	*P. aphanidermatum*
Helianthus annuus	*P. aphanidermatum*
Heterodera avenae (Nematode)	*P. aphanidermatum*
Hordeum vulgare	*P. graminicola*
Hyoscyamum muticus	*P. aphanidermatum, P. spinosum*
Indigofera arrecta	*P. indigoferae*
Ipomoea pulchella	*P. aphanidermatum*
Kalanchoe mortagei	*P. aphanidermatum*
Lab-lab purpureus	*P. aphanidermatum, P. middletonii*
Lactuca sativa	*P. aphanidermatum*
Lagenaria leucantha	*P. aphanidermatum*
Lagenaria siceraria	*P. aphanidermatum*
Lagenaria sp.	*P. aphanidermatum*
Lagenaria vulgaris	*P. aphanidermatum*
Lagerstroemia sp.	*P. middletonii*
Lens culineris	*P. debaryanum*
Lepidium sativum	*P. debaryanum, P. monospermum*
Leucaena leucocephala	*P. aphanidermatum, P. myriotylum,* *P. ultimum var. ultimum*
Linum grandiflorum	*P. aphanidermatum*
Linum usitatissimum	*P. ultimum* var. *ultimum*
Luffa acutangula	*P. aphanidermatum*
Luffa aegyptica	*P. aphanidermatum*
Luffa cylindrica	*P. aphanidermatum*
Lycopersicum esculentum	*P. aphanidermatum, P. aquatile, P. debaryanum* *P. inflatum, P. polytylum, P. ultimum* var. *ultimum,* *P. vexans,*
Malus sp.	*P. debaryanum*
Momordia cochinchinensis	*P. aphanidermatum*
Nicotiana tabacum	*P. aphanidermatum, P. debaryanum, P. myriotylum*
Olpidiopsis indica (fungus)	*P. aphanidermatum*
Opuntia dillenti	*P. aphanidermatum*
Oroxylum indicum	*P. intermedium*
Oryza sativa	*P. graminicola, Pythium sp.*
Oryza sp.	*P. inflatum*

Contd...

1	2
Papaver sp.	*P. aphanidermatum*
Pelargonium graveolens	*P. splendens*
Pelargonium sp.	*P. vexans*
Pennisetum americanum	*P. aphanidermatum*
Pennisetum typhoides	*P. aphanidermatum*
Phaseolus radiatus	*P. debaryanum*
Phaseolus vulgaris	*P. aphanidermatum, P. paroecantdrum*
Piper betle	*P. oligandrum, P. vexans*
Piper longum	*P. vexans*
Pisum sativum	*P. ultimum* var. *ultimum*
Pyrus malus	*P. ultimum* var. *ultimum, P. vexans*
Raphanus sativus	*P. aphanidermatum, P. middletonii*
Raphanus sativus var. *caudalus*	*P. aphanidermatum,P. aphanidermatum, P. debaryanum, P. middletonii*
Ricinus communis	*P. monospermum*
Saccharum officinarum	*P. debaryanum, P. graminicola, P. catenulatum*
Saponaria sp.	*P. deliense*
Sesbania aculeata	*P. aphanidermatum*
Solanum khasianum	*P. aphanidermatum*
Solanum laciniatum	*P. aphanidermatum*
Solanum melongena	*P. aphanidermatum*
Solanum tuberosum	*P. aphanidermatum, P. hydnosporum, P. ultimum* var. *ultimum*
Sorghum vulgare	*P. graminicola*
Spinacea oleracea	*P. debaryanum*
Spirogyra sp.	*P. carolinianum, P. catenulatum*
Talinum triangulare	*P. aphanidermatum*
Tephrosia vogelii	*P. deliense*
Trichosanthes anguina	*P. aphanidermatum*
Trichosanthes dioca	*P. aphanidermatum, P. cucurbitacearum* *P. deliense, P. echinulatum, P. graminicola, P. rostratum*
Triticum aestivum	*P. spinosum, P. torulosum, P. ultimum var. ultimum*
Vicia faba	*P. graminicola*
Vigna unguiculata	*P. debaryanum*
V. radiata	*P. debaryanum*
V. sinensis	*P. aphanidermatum*
Vitis vinifera	*P. debaryanum*
Zea mays	*P. aphanidermatum, P. graminicola* *P. acanthophoron, P. aphanidermatum, P. graminicola*
Zingiber officinale	*P. monospermum, P. myriotylum, P. ultimum* var. *ultimum, P. vexans*
Zingiber sp.	*P. splendens*

Checklist 3

Hosts and family

Host 1	Family 2
Abelmoschus esculentus	Malvaceae
Abelmoschus sp.	Malvaceae
Albizia falcatasia	Mimosaceae
Allium cepa	Liliaceae
Amaranthus gangeticus	Amranthaceae
Amaranthus sp.	Amranthaceae
Amaranthus tricolor var. *gangeticus*	Amranthaceae
Arachis hypogaea	Papilionaceae
Aframomum melegueta	Zingiberaceae
Atropa belladona	Solanaceae
Avena sativa	Poacea
Azadirachta indica	Meliaceae
B. oleraceae var. *capitata*	Brassicaceae
B. oleraceae var. *caulorapa*	Brassicaceae
Balariane sp.	
Beeta vulgaris	Chenopodiaceae
Belladona sp.	Solanaceae
Brassica campestris	Brassicaceae
Brassica campestris var. toria	Brassicaceae
Brassica juncea	Brassicaceae
Brassica, oleraceae var. *botrytis*	Brassicaceae
Cajanus cajan	Leguminaceae
Capsicum annuum	Solanaceae
Capsicum indicum	Solanaceae
Capsicum spp.	Solanaceae
Carassius autarus	Fish
Carica papaya	Caricaceae
Carthamus tinctorius	Asteraceae
Catharanthus roseus	Apocyanaceae
Cicer arietinum	Papilionaceae
Cinchona ledgeriana	Rubiaceae
Cinchona officinalis	Rubiaceae
Cinchona sp.	Rubiaceae
Cinchona succirubra	Rubiaceae
Citrullus fistulosus	Culurbitaceae
Clarkia sp.	Onagraceae
Cocos nucifera	Arecaceae
Colocynthus citrullus	Cucurbitaceae
Coriandrum sativum	Apiaceae
Costus sp.	Zingiberaceae
Costus speciosus	Zingiberaceae
Crotolaria juncea	Papilionaceae
Cucumis melo	Cucurbitaceae
Cucumis sativus	Cucurbitaceae
Cucumis utilissimus	Cucurbitaceae
Curcuma longa	Zingiberaceae
Cyamopsis tetragonoloba	Papilionaceae
Cymbopogon martinii	Poaceae
Cymbopogon winterianus	Poaceae
Cyperus alternifolius	Cyperaceae
Cyperus eleusinoides	Cyperaceae
Cyperus papyrus	Cyperaceae
Dioscorea composita	Dioscoreaceae
Dolichos lablab	Papilionaceae
Elettaria cardamomum	Zingiberaceae
Eleusine corecana	Poaceae
Eucalyptus grandis	Myrtaceae
Eucalyptus tereticornis	Myrtaceae
Eucalyptus tessellaris	Myrtaceae
Gilia sp.	Polymoneaceae
Gossypium sativum-cotton seedlings	Malvaceae
Hardwickia binata	Caesalpiniaceae
Helianthus annuus	Asteraceae
Heterodera avenae	Nematode
Hordeum vulgare	Graminaceae
Hyoscyamus muticus	Solanaceae
Indigofera arrecta	Papilionaceae
Ipomoea pulchella	Convolvulaceae
Kalanchoe mortagei	Crassulaceae

Contd...:

Contd...

1	2
Lab-lab purpureus	Papilionaceae
Lactuca sativa	Asteraceae
Lagenaria leucantha	Cucurbitaceae
Lagenaria siceraria	Cucurbitaceae
Lagenaria sp.	Cucurbitaceae
Lagerostoemia sp.	Lythraceae
Lens culineris	Papilionaceae
Lepidium sativum	Brassicaceae
Leucaena leucocephala	Mimosaceae
Linum grandiflorum	Linaceae
Linum usitatissium	Linaceae
Luffa acutangula	Cucurbitaceae
Luffa aegyptica	Cucurbitaceae
Luffa cylindrica	Cucurbitaceae
Lycopersicum esculentum	Solanaceae
Malus sp.	Rosaceae
Momordia cochinchinensis	Cucurbitaceae
Nicotiana tabacum	Solanaceae
Olpidiopsis indica	Fungus
Opuntia dillenti	Cactaceae
Oroxylum indicum	Bignoniaceae

Contd...

1	2
Oryza sativa	Poaceae
Oryza sp.	Poaceae
Papaver sp.	Papavaraceae
Pelargonium graveolens	Geraniaceae
Pelargonium sp.	Geraniaceae
Pennisetum americanum	Poaceae
Pennisetum typhoides	Poaceae
Phaseolus radiatus	Papilionaceae
Phaseolus vulgaris	Papilionaceae
Piper betle	Piperaceae
Piper longum	Piperaceae
Pisum sativum	Papilionaceae
Pyrus malus	Rosaceae
Raphanus sativus	Brassicaceae
Raphanus sativus var. *caudalus*	Brassicaceae
Ricinus communis	Euphorbiaceae
Saccharum officinarum	Poaceae
Saponaria sp.	Caryophyllaceae
Sesbania aculeata	Papilionaceae
Solanum khasianum	Solanaceae
Solanum laciniatum	Solanaceae

SUMMARY

This communication embodies the checklists of hosts, their families and the diseases caused by various known species of the fungal genus *Pythium* in India.

भारत में *पायथियम* प्रजाति के पोषी और रोगजन जाति संयोग

वी॰के॰ तिवाड़ी व जे॰के॰ मिश्र

सारांश

इस अभिपत्र में भारत की कवक प्रजाति *पायथियम* की ज्ञात विविध जातियों से उनके पोषियों, उनके कुलों तथा उनसे होने वाले रोगों की पड़ताल सूचियां दी गई हैं ।

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STANDARDIZATION OF PROPER VOLUME/SIZE AND TYPE OF ROOT TRAINER FOR RAISING *ACACIA NILOTICA* SEEDLINGS : NURSERY EVALUATION AND FIELD TRIAL

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Introduction

Raising seedlings of tree species in nurseries is a common phenomenon in present day plantation forestry the world over. In India, most of the forest nurseries use polythene bags for raising plants. Very few species are planted bare rooted or with stumps. The disadvantages of polybags are numerous and are explained in detail by Josiah and Jones (1992) and Khedkar and Subramaniam (1996, 1997). The biggest disadvantage with polythene bags is coiling of roots which hampers the growth of plant. The tap root in polythene bag when strikes the bottom generally fails to penetrate the wall of polythene bag and starts coiling. Even if it is able to penetrate the bottom of polythene bag, it spreads out into the nursery bed. Such seedlings, when lifted, suffer a severe root shock, often resulting in heavy mortality. The seemingly healthy plant with such a root system fails to withstand even moderate pressure and are remain prone for wind throw because of shallow root system (Nanhorya *et al.*, 1999). Very often the coiled root strangulates itself as it grows, leading to stunted growth and untimely death of plant (Anon., 1999). Though Napier and Willan (1983) and Chaturvedi (1994) have suggested that the coiled root plants be tended before planting but such an exercise is not feasible in the field at the time of planting (Nanhorya *et al.*, 1999) and also is not economical.

In production forestry, there is a common interest to produce quality seedlings by application of improved nursery techniques. The objective is to produce sturdy seedlings by inducing morpho-physiological changes. Such seedlings are hardy enough to bear the shock of field planting and side by side enhance their productivity also. Looking at the disadvantages of polythene bags, Josiah and Jones (1992) have favoured root trainer technology for raising plants in forest nurseries, though Gera *et al.* (1998) have suggested the use of mounted angle iron beds. But in general it is an accepted fact world-wide that root trainer technology is the best for raising plants in nurseries. This technology had been adopted in Western countries as early as in the 1940s but in majority of forest nurseries in India this technology was not adopted even till late 1990s (Nanhorya *et al*. 1999).

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Thus consideration is required to be given on the production of morphologically sound seedlings with well developed fibrous root system. Research work is needed for use of different seedling production system. We can no longer afford to continue with the traditional polythene bag system alone as long term results of this system are devastating. In the tropical region, containerised seedling planting is still a common process. It has to be supplemented with root trainer system which is more cost-effective and improved seedling production system. However, before adopting this technology in large scale in our nurseries, it has to be standardized. Species specific research is required, in order to develop a complete package of this system for tropical tree species.

In the present investigation, an attempt has been made to find out the optimum cell size/volume and type of root trainer required for raising *Acacia nilotica* seedlings in nursery.

Material and Methods

The experiment was conducted during March, 1998 through July, 2000 in the nursery and experimental area of Silviculture Division of Tropical Forest Research Institute, Jabalpur.

Following volumes/sizes and type of root trainers were used in the experiment as treatments :

Treatments	Size and type of root trainer	
T_1	Hiko Pots,	90 cc
T_2	Hiko Pots,	150 cc
T_3	Hiko Pots,	300 cc
T_4	Book Type,	200 cc
T_5	Single Cell,	290 cc

The experimental design used was randomised blocks with 3 replications. A total of 40 seedlings were used in each replication, thus totaling 120 seedlings per treatment. A uniform potting mixture, i.e., 80% compost and 20% sand was used in the root trainers. This potting mixture was decided on the basis of our preliminary experimental results for proper potting mixture under root trainer seedling production system for some species. Each ingredient of potting mixture was sun dried and pulverized and then sieved separately through a wire mesh. The entire potting mixture was then mixed up for filling up the open ended root trainer blocks. A ball of potting mixture was made by sprinkling water and placed at the bottom of the block. The potting mixture was then filled in upto the top and gently pressed with the help of finger tips.

Seeds of *Acacia nilotica* were given a uniform pretreatment, i.e. boiling water for 4 minutes and then soaking in warm water for 24 hours. Seeds were pre-germinated in a moisten cloth. The pre-germinated seeds were sown in the root trainer cells as per the design on the same day. The seedlings were maintained by regular watering (twice a day upto the saturation limit of potting mixture), weeding and were provided 75% shade with agro-shade net during the whole month of May and upto mid-June.

Observations of 3 month old seedlings on different morphological parameters, viz., seedling height, collar diameter, number of leaves were recorded in the first week of July 1998. In order to study the root system and biomass, 10 seedlings per replicate were removed from the root trainer cells. The root plug containing potting mixture was gently washed with water till all the adhering particles of potting mixture were washed away from the root system. The root characteristics like tap root length, number of lateral roots, number of root nodules and average length of roots were recorded. The seedlings of each treatment and replicate were then divided into its various parts like shoot, leaves, root nodules, tap root, fibrous roots, etc. and were oven dried at 70°C. Biomass of various seedling components was measured and then above-ground biomass, below-ground biomass and root : shoot ratio (on biomass basis) were calculated. The seedling quality parameters, viz. sturdiness (the ratio of height to diameter), root/shoot ratio and the ratio of fibrous root biomass to total root biomass were calculated for each treatment. Dickson quality index [seedling weight (g)/height diameter ratio] was calculated following Chauhan and Sharma (1997). The root surface area was determined as per the method given by Ansari *et al.* (1995).

A part of the seedlings of this experiment were field planted in the experimental area located in TFRI campus in complete randomized block design with 3 replications. The same replicates of the nursery were used in the plantations. Planting was carried out in pits of size 45 cm^3 at a spacing of 2 x 2 m in the second week of July 1998. A total of 27 seedlings were planted in each treatment. The plantation area has semi-arid type of climate with mean annual rainfall 1358 mm. Soil of the study site belongs to red and black soil group. The seedlings were maintained for weeding etc. but no irrigation was provided. The data on survival and growth was recorded after two years of field planting i.e. in July 2000.

The data thus obtained in respect of various parameters of the seedlings in the nursery and field were analysed statistically for the analysis of variance (ANOVA) and further least significant differences (LSD) were calculated using a computer program SX.

Results and Discussion

The mean values on morphological observations on nursery growth parameters of 3 month old seedlings raised under different treatments are given in Table 1. The effect of different volume and type of root trainer was found to be statistically significant in respect of seedling height ($P<0.001$), collar diameter ($P<0.001$), number of root nodules ($P<0.05$), and average length of lateral roots ($P<0.001$). However the seedling tap root length, number of lateral roots and number of leaves per seedling did not differ significantly.

Maximum seedling height was observed (69.80 cm) in treatment T_3 followed by T_2 (58.30 cm) and T_4 (53.30 cm) which were observed to be statistically at par with each other. The collar diameter also followed a similar trend, depicting a significantly maximum in T_3 (4.34 mm) followed by T_2 (3.71 mm), T_4 (3.63 mm) and T_5 (3.46 mm) treatment. No significant

Table 1

Mean values of morphological observations on nursery growth of Acacia nilotica seedlings

Volume and type of root trainers (Treatments)	Seedling height (cm)	Collar dia (mm)	Tap root length (cm)	No. of lateral roots	No. of root nodules	Av. length of lateral roots (cm)	No. of leaves
T_1	43.10 d	3.07 c	5.96	50.33	4.66 b	4.75 c	11.67
T_2	58.30 b	3.71 b	7.20	40.00	4.33 b	5.66 b	10.67
T_3	69.80 a	4.34 a	7.30	50.00	7.00 ab	7.06 a	16.67
T_4	53.30 bc	3.63 b	8.26	49.67	8.00 a	7.56 a	18.00
T_5	50.60 c	3.46 b	7.80	39.00	7.66 a	5.36 b	16.33
F test	***	***	NS	NS	*	***	NS
CD. at 5%	5.87	0.269	-	-	2.906	0.582	-
SEm±	2.54	0.116	-	-	1.26	0.252	-

Significance level *$P<0.05$, ***$P<0.001$, NS - Non Significant
Means followed by the same letter (s) do not differ ($P>0.05$) by least significant difference.

difference between the treatments T_2, T_4 and T_5 was observed. A significantly minimum collar diameter (3.07 mm) was recorded in T_1.

Average number of root nodules (seedling^{-1}) were observed maximum (8.00) in T_4 though it did not vary significantly from T_5 (7.66) and T_3 (7.00) treatments. Similarly average length of lateral roots was found maximum in T_4 (7.56 cm) and T_3 (7.06) treatments which are also statistically at par. It was recorded minimum in T_1 (4.75).

The effect of various treatment also caused appreciable variation in tap root length 5.96 - 8.26 cm (T_1-T_4) number of fibrous and lateral roots 39.00 - 50.33 (T_5-T_1) and average number of leaves 10.67 - 18.00 (T_2-T_4). However the treatment effect was not significant in respect of those traits.

From the morphological observations of seedlings raised under various volumes and types of root trainers. It is quite clear that the T_3 treatment i.e. Hiko tray 300 cc cell volume is fairly better for enhancing the physical sturdiness of the seedlings. The performance of 150 cc cell volume Hiko tray was also satisfactory.

The dry matter production (biomass) in seedlings raised under various sizes/volumes and types of root trainers is given in Table 2. The effect of treatments was found statistically significant in respect of various traits recorded like shoot biomass ($P<0.01$), root nodules biomass ($P<0.05$), tap root biomass ($P<0.01$), fibrous and lateral root biomass ($P<0.01$), above ground biomass ($P<0.001$), under ground biomass ($P<0.01$) and total seedling biomass ($P<0.001$). The leave biomass did not differ significantly with the treatments.

Table 2

Biomass production (g seedling^{-1}) under different treatments in seedlings of Acacia nilotica

Volume and type of root trainers (Treatments)	Shoot biomass	Leave biomass	Above ground biomass	Root nodule biomass	Tap root biomass	Fibrous and lateral root biomass	Under ground biomass	Total biomass
T_1	1.57 c	1.01	2.58 d	0.126 b	1.10 c	1.16 c	2.39 cd	4.97 d
T_2	2.43 bc	1.09	3.52 bc	0.146 ab	1.30 ab	1.21 bc	2.65 bc	6.18 bc
T_3	3.74 a	1.24	4.98 a	0.160 a	1.37 a	1.55 a	3.08 a	8.06 a
T_4	1.99 bc	1.16	3.15 cd	0.120 b	1.20 bc	1.21 bc	2.53 cd	5.68 c
T_5	2.69 b	1.18	3.87 b	0.131 b	1.29 ab	1.39 ab	2.82 ab	6.69 b
F test	**	NS	***	*	**	**	**	***
CD at 5%	0.999	-	0.582	0.027	0.115	0.211	0.248	0.628
SEm ±	0.433	-	0.252	0.019	0.005	0.091	0.107	0.272

Significance level *$P<0.05$, **$P<0.01$, ***$P<0.001$, NS - Non Significant.
Means followed by the same letter (s) do not differ ($P<0.05$) by least significant difference.

The seedling shoot biomass (g seedling^{-1}) (without leaves) was recorded significantly maximum 3.74 in T_3, followed by 2.69, 2.43 and 1.99 in T_5, T_2 and T_4 treatments respectively, which are statistically at par. The T_1 treatment resulted in minimum shoot biomass (1.57 g seedling^{-1}) though it's performance is at par with T_4 and T_2 treatment.

Similarly the above-ground biomass (g seedling^{-1}) was observed significantly maximum 4.98 in T_3, followed by a statistical group of two treatments i.e. T_5 and T_2 which are on par. The T_1 treatment produced the minimum biomass (2.58 g seedling^{-1}).

The biomass of root nodules was also observed maximum in T_3 (0.16 g seedling^{-1}) though it is on par with T_2 (0.146 g seedling^{-1}). The tap root biomass was again observed significantly maximum in T_3 (1.37 g seedling^{-1}) though it did not differ with T_2 treatment (1.30 g seedling^{-1}).

Another important trait determining the sturdiness in the seedling is the biomass of fibrous and lateral roots. This trait was significantly maximum in T_3 (1.55 g seedling^{-1}) though it is statistically on par with T_5 (1.39 g seedling^{-1}).

Underground biomass and the total seedling biomass followed a similar trend. Both the traits were found significantly maximum in T_3 followed by T_5 and T_2. The T_1 treatment recorded in the lowest biomass production in the seedling.

From the observations, it appears that the Hiko trays 300 cc cell volume, which is the maximum volume being tested in the experiment showed a good performance of

Table 3

Quality parameters of Acacia nilotica seedlings raised under different volume and type of root trainers

Treatment	Root/shoot ratio	Ratio of fibrous/total root biomass	Dickson quality index	Root surface area (cm^2 $seedling^{-1}$)
T_1	0.926	0.485	0.035	42.95
T_2	0.753	0.456	0.039	58.75
T_3	0.618	0.503	0.050	87.56
T_4	0.803	0.478	0.039	50.79
T_5	0.728	0.493	0.046	75.79

the seedlings under it. It is quite obvious also, because of greater space available for the root system to expend and develop. However, in respect of some traits like number of root nodules, their biomass, tap root biomass and underground biomass this treatment appeared on par with T_2 and T_5 treatments. This indicates that with increasing volume of root trainer cells, the seedling quality can not be changed significantly.

The seedling quality parameters, which were calculated on the basis growth and biomass observations are presented in Table 3. The pattern of root shoot ratio across various treatments is not very appreciable and does not match to the confirmation of nursery results.

On the basis of the ratio of fibrous root biomass with total root biomass, the treatments can be arranged in descending order as per the quality of seedlings i.e. 0.503 (T_3), 0.493 (T_5), 0.487 (T_1), 0.478 (T_4) and 0.456 (T_2). The higher the ratio of fibrous root biomass with total root biomass, the better will be quality of the seedling. The root surface area (cm^2 $seedling^{-1}$) of the fibrous root system clearly indicates that the seedlings raised under T_3 have maximum area (87.56) followed by T_5 (75.79) and T_2 (58.75). This pattern clearly supports there findings of nursery results. A large root area is a good indicator of absorptive root surface, survival and productivity of seedlings. The Dickson quality index also appeared in the similar trend giving higher score to T_3 treatment.

It is a wise step to compare the seedlings of various treatments on the basis of quality parameters, rather on actual values on height or collar diameter. Seedling quality specifications have traditionally been based on certain morphological characteristics such as sturdiness (height/diameter ratio), root/shoot ratio and some other features (Aldhous, 1976; Cleary *et al*, 1978; Lavender and Cleary, 1974; Schmidt-Vogt, 1974). From the seedling quality parameters it is evident that the T_3 treatment scored significantly and maintained its superiority throughout. The performance of T_2 and T_5 treatments is also satisfactory and can be placed next to T_3 treatment in the order of choice. The T_1 treatment did not fit for

Table 4

Field performance of Acacia nilotica seedlings (two year growth)

Volume and type of root trainer	Plan height (cm)	Collar dia. (mm)	Field survival (%)
T_1	63.71 bc	7.57 c	70.83 bc
T_2	77.80 b	9.97 a	72.83 abc
T_3	93.33 a	9.78 a	86.67 a
T_4	82.22 b	8.42 bc	61.33 c
T_5	86.25 ab	9.22 bc	82.50 ab
F test	**	*	*
CD at 5%	10.73	1.31	15.21
SEm ±	4.65	0.57	6.59

Significance level, $^*P<0.05$, $^{**}P>0.01$.
Means followed by the same letter (s) do not differ ($P>0.05$) by least significant difference.

raising quality seedlings of *Acacia nilotica* in nursery.

The observations on two years field performance of the seedlings (Table 4) revealed that the seedlings raised in T_3 (Hiko trays, 300 cc cell volume) treatment achieved maximum height (93.33 cm), collar diameter (9.78 mm) and survival (86.67%). A noticeable point is that, the performance of T_2 and T_5 treatments is statistically on par with T_3 treatment in case of collar diameter and field survival. However for plant height the T_3 treatment appeared statistically equal with T_5. In nut shells, though the T_3 treatment has maintained its superiority throughout the nursery stage and also in the plantations but its performance is comparable with T_2 and T_5 treatments. This also appeared in several traits of the nursery stage performance.

Result indicates that, there is a choice with the nursery manager in case of picking up a right type and size of root trainer for raising seedlings of *A. nilotica* in nursery. The results explains that the preference shall be given to Hiko trays of 300 cc cell volume, but if there is a constraint of space in the nursery and the objective is to produce maximum number of seedlings per unit area space of the nursery, there is no harm in going for Hiko trays 150 cc volume. This probably will also reduce the nursery production cost of the seedlings to a fair extent. The single cell bullet type (290 cc volume) is also equally good. Going for single sell (290 cc) will be little uneconomical in comparison to Hiko trays 150 cc, because of its larger volume, requiring more space, potting mixture, maintenance cost and the number of plants produced per unit area of nursery space will be less. Moreover volume of single cell (290 cc) and Hiko trays (300 cc) is comparable, and there is no point in going for the less superior one.

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SUMMARY

Root trainers are increasingly being used to deal with the problem of root coiling in polybag grown seedlings. However, the technology has not been standardized for most of the tropical tree species. In a multivariate investigation involving 5 type of root trainers namely Hiko pots 90 cc, 150 cc, 300 cc, Book type 200 cc, and Single cell bullet type 290 cc, growth performance of *Acacia nilotica* seedlings was assessed on the basis of seedling quality parameters. The performance of the seedlings was also assessed in the field for two years. The seedlings raised in 300 cc Hiko pots performed the best in nursery as well as in the field. However, the performance of Hiko tray 150 cc cell volume and Single cell 290 cc appeared statistically equal with the Hiko tray 300 cc cell volume after two years field performance of seedlings. The results are indicative that, though Hiko trays 300 cc cell volume is the best size and type of root trainer for *A. nilotica*, however, when there is a space constraint in nursery and the objective is to raise more number of seedlings per unit area of the nursery space, the Hiko tray 150 cc volume is equally good.

अकेसिया नीलोटिका के पौधे उगाने के लिए उपयुक्त आयतन/आकार और जड़ प्रसाधक का मानकीकरण : रोपणी मूल्यांकन और क्षेत्र परीक्षण

एच०एस० गिनवाल, पी०एस० रावत, संदीप शर्मा, ए०एस० भण्डारी, सी० कृष्णन् व पी०के० शुक्ल

सारांश

पोलिथीन थैलियों में उगाए पौधों की जड़ें मुड़ जाने की समस्या से निबटने के लिए जड़ प्रसाधकों का उपयोग निरन्तर बढ़ रहा है । तथापि अधिकाशं उष्ण वृक्ष जातियों की यह प्रौद्योगिकी अभी प्रतिमानित नहीं बन पाई है । इस बहुविचर अन्वेषण में, जिसमें पांच प्रकार के जड़ प्रसाधक अर्थात् हाइको गमले 90 सीसी, 150 सीसी, 300 सीसी, बुक प्रकार के 200 सीसी और एककोशीय बुलेट प्रकार 290 सीसी (= घन सेमी) लिए गए, *अकेसिया नीलोटिका* के पौधों की वृद्धि सक्रियता पौधों के गुणवत्ता परिमापों के आधार आकलित की गई । पौधों की सक्रियता दो वर्षो तक क्षेत्र में जांचकर देखी गई । 300 घन सेमी हाइको गमलों में उगाए पौधे रोपणी और क्षेत्र दोनों जगहों में सबसे ज्यादा सक्रिय निकले । तथापि हाइको तश्तरी 150 घन सेमी कोशा आयतन और एकल कोशा 290 घन सेमी की क्रियाशीलता की सांख्यिकीय दृष्टि से हाइको तश्तरी 300 घन सेमी कोशा आयतन के बराबर ही पौधों की सक्रियता के दो वर्षो तक क्षेत्र परीक्षण करते रहने के बाद दिखाई पड़ी । ये परिणाम सूचित करते हैं कि हालांकि *अकेसिया नीलोटिका* के लिए हाइको तश्तरी 300 घन सेमी कोशा आयतन ही सबसे अच्छा आकार और जड़ प्रसाधक है, तथा इसमें रोपणी में जगह कम मिलने की बाधा रहती है और उद्देश्य होता है रोपणी क्षेत्र में प्रति क्षेत्र इकाई अधिक से अधिक पौधे उगाना, इसलिए हाइको तश्तरियां 150 घन सेमी आयतन भी इतनी ही अच्छी रहती है ।

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TRADITIONAL INITIATIVES IN PARTICIPATORY FOREST MANAGEMENT : DODRA-KWAR (SHIMLA - H.P.) EXPERIENCE

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Introduction

Among earliest evidences of recorded and unrecorded cases of participatory forest management are those available in North-Western Himalayas. Most of these cases of people's participation in forest resource management and use (with or without change) are still functioning without outside intervention and financial support. Creation of forest committees commonly called as "Van Panchayats" for the management of civil forests in Kumaon and Garhwal hills of Uttar Pradesh during 1920s and thereafter (Ballabh and Singh, 1988; Saxena, 1995) and that of cooperative societies for the management of undemarcated protected forests, unclassed forests and village common lands in Kangra (H.P.) in 1939 (Chaudhary, 1945; Agarwal and Singh, 1995; Sharma, 1998) were among the earliest attempts of Forest Departments to enter in collaboration with villagers for the management of forests. In these cases arrangements were made for the management of forests, distribution of forest products and sharing of income generated from the sale of forest products, between Forest Departments and committees/societies.

Though Himachal Pradesh is one of the 22 States to have issued JFM notification and incorporated its principles in forest working, there are numerous traditionally *in-vogue* successful cases of people's active participation in forest resource management especially in the regulated collection and distribution of forest products in its remote hills. Some unrecorded successfully functioning cases are very old, period of their initiation and/or maturity (period when these were initiated and matured) to the present status is not known even to the locals who remained active participants in their evolution and functioning. Such cases are wide spread in the inner and upper Himalayan ranges viz., Kinnaur, Chamba, Kullu and Shimla Districts in which committees of nominated, elected or deity members plan and organise their functioning without written procedures. These appear to have served as the source of inspiration and information for initiating organised and planned Joint Forest Management (JFM) programme in the State and elsewhere. This paper presents one such case of Jakha Panchayat in Dodra-Kwar Sub-division of Shimla District, Himachal Pradesh.

Study Area

Dodra-Kwar, with a geographical area of 36,697 ha and human population of approximately 6,000 is a land-locked and most remote sub-division of Shimla District in Himachal Pradesh. Kwar, the headquarters of the sub-division is situated at 2,590m above mean sea level and is approached after approximately 12 hrs walking distance from the nearest road head i.e. Ladot. It is a sub-division of three panchayats viz., Jakha, Dodra and Kwar and is located in the extreme Northeast of the State bordering UP in eastern side and Kinnaur District in the northern side.

Jakha Panchayat with a geographical area of 26,888 ha, has three main villages viz., Jakha, Pandar and Jiskoon with many small hamlets attached to these villages. Jiskoon is the main village of Jakha Panchayat and the main market place of the sub-division. It takes approximately 3 hrs to reach Jiskoon from Dodra and 1.5 hrs from Kwar. There are 283 households in the panchayat with human population of 1,754 and that of animals as approximately 3500 heads. Panchayat area falls under three forest beats viz., Manjran, Pandar and Jakha-Jiskoon of Dodra-Kwar Forest Range.

People of the area are mostly agriculturists and are largely dependent on natural resources for sustenance and maintenance of their life and that of their herds. The area has rich forests of numerous tree, shrub and herb species, many of which have high economic, social and ecological value for locals and outsiders. People have recorded rights in the surrounding forests for getting trees under timber distribution system for repair and construction of buildings and agricultural implements, grazing of animals, grass and fodder collection for cattle feed, fuelwood for domestic and funeral purposes, collection of needles and twigs for cowsheds and manure and, collection of medicinal herbs for domestic use and sale. There is increased dependence of people on village common lands, unclassed and undermarcated protected forests located near the villages than on those situated away from them.

People's collective initiatives in forest management are very old in the area and are spread in the entire sub-division. The information on the system, its functioning collection and distribution of the forest products was obtained through personal contacts and interviews with the people of the panchayat and those of village committee members during Nov.-Dec. 1999 and reported hereunder.

Village committee and its functioning

The area has an age-old system of management, organisation, collection and distribution of most of the non-timber forest products with the active participation of different family members of the panchayat. In old days, the system worked under the control of a local deity through a committee of the members whose membership remained inherited to specific families. However, in 1982, it was taken over by the newly constituted committee of 20 members. Committee thereafter has a President, Vice President, Cashier, Messenger and a Record Keeper. The rest of the persons are ordinary members of the committee. There is no outside interference in the working of the committee, nor there are written procedures to regulate its working.

Committee holds its meeting well in advance of the collection/distribution of the forest products in which one member from each family of the panchayat participates. Absentees are charged with a fine of Rs. 50/family and this amount is credited to the committee fund. The notice of the meeting is communicated through the Messenger who gets around Rs. 50 from this account for communicating the message. Committee is chaired by the President or by the Vice President or some senior member in his absence to decide the agenda of the meeting. Management and collection of some of the products has been systematized through initiatives of this local institution. Verbal instructions issued by it are strictly adhered to and conflicts, if any, are resolved amicably with or wihout fines. There are different approaches for collection/distribution of different products and are separately discussed below.

Grass cutting : Panchayat has earmarked Undemarcated Protected Forests (UPF) viz., UPF 69B Pandar, UPF Raigod and UPF Mantianto for grass cutting and are located about 1-2 km from the village. Main tree species of these forests are Mohru (*Quercus dilatata*), Kharsu (*Q. semecarpifolia*), Walnut (*Juglans regia*), Deodar (*Cedrus deodara*), and Kail (*Pinus wallichiana*). Grass in the area is cut in Sept-Oct. (before Diwali). Meeting of the Committee is held in April to decide the closure of the area, fines and procedure for settling conflicts and offences.

Panchayat has 8 caste groups locally called as "viradries". The total grass production area was first divided among these viradries and then to families since times immemorial and is inherited through generations. Forest area with each family has been marked on the ground and no other family encroaches upon it. Grass cutting area allotted to a family has undergone many divisions to small patches in the subsequent generations.

The protection of the area from grazing, illicit grass cutting and damage generally starts after the committee meeting in April. Damage caused to any area is brought to the notice of the Committee. Committee on spot inspection of the damage gives notice to the offenders (pointed out by the family whose area has been damaged) to appear in front of the Committee on the designated date and time. If offender agrees to having caused the damage, he is fined with an amount varying from Rs. 50 to Rs. 500, depending upon the extent of damage. If he does not accept the guilt then he is asked to intimate the name of the actual offender and till then the case is kept pending. In case the offence is proved against a person and he does not accept it, committee members feel that under such an eventuality offender can be handed over to the police with a recommendation to initiate proceedings against him. However, strong interdependence of families, strong social bonds and fear of alienation in the village compel the offender to accept the guilt.

The fine collected from the offender is given to the person whose area has been grazed/damaged and to the Messenger. Messenger gets amount Rs. 5 to Rs. 20 through the President of the Committee depending upon the distance he covers to communicate the message. Only 5-10 cases of such nature are reported each year. Area has only one main path and the offender is easily marked and identified.

After grass cutting, area is made opened for free grazing and there are no restrictions till next year when the protection of the area restarts. Each family gets about 8-10 qtls grass from the closed area.

Animal grazing : Villagers send their cattle, during summer months, for grazing to higher reaches commonly called Kanda (UPF Lambidhar, UPF Dabralidhar and UPF Rasrang). These areas are annually divided among the villagers for grazing purposes. Prior to 1982, DPF-Dodu forest was exclusively kept for local deity and the sale proceeds from this forest were deposited into his account. Thereafter, deity is equal partner in the distribution of the area. The distribution of the area is decided in a meeting in which members of the deity committee is also invited and villagers are asked to prepare the inventory of cattle and make groups (locally called "tollies"). Each group represents approximately 500 cattle of 10-20 families based on cattle population and compatibility among the members. Jakha Panchayat generally makes 4 tollies of cattle and 2 of non-cattle families. Thus there are 7 parties including one that of the deity for the distribution of Kanda area. Total Kanda area is divided in 7 parts based on the productivity and natural boundaries. Area for the deity is allotted by the general consensus. Other 6 areas are written on separate slips of paper and then deity member picks up and distributes the areas among six parties. Distribution of the area by the deity member is accepted by all the members. Each group then grazes their cattle in only the allotted area.

Animals of the villagers migrate to the grazing area during May after spending winters in low-lying areas. Each group is given the right of path and one halt wherever they feel to spend a night on the way. Deliberate and excessive halts on other's land are viewed as offence and are charged with fines. Fines are also charged for grazing in other allotted areas. Sometimes migratory graziers from other villages also pass from these areas. These graziers are allowed one halt within the panchayat boundaries. If the halts are in excess, they are fined with one male goat, which is handed over to the deity. Deity uses these goats for meat which is served to the people during local fares and other social and religious ceremonies.

Area earmarked for the deity is sold to outsiders and the sale proceeds are deposited in the deity account. It has been sold up to Rs. 2,500 in different years. Similarly the area allotted to the groups who do not own cattle for grazing is also sold during June-July and the sale proceed is equally distributed among the members of that group.

Tree lopping : Green fodder in the area is not readily available during summer and winter months because of low land holding and rainfed cultivation. People during these months lop trees from agricultural and forest lands for meeting their fodder requirement. Trees of Kharsu, Mohru, Walnut etc. occurring mostly in and around agricultural fields and UPF forests are lopped for fodder, which is fed either *in-situ* when a big herd of cattle is taken to the base of the trees to browse the lopped fodder or is stall fed in case of some animals being maintained in cowsheds.

Trees lopped for fodder whether occurring in common land or in forests, have been permanently distributed among the villagers since times immemorial. About 5,000 such trees of mostly Kharsu and Mohru Oak occurring in Jakha Panchayat have been permanently distributed among its families. Trees owned by a family are inherited by its subsequent generation and right of lopping is not transferred to others. People judiciously lop trees only in alternate years. Each middle-aged tree yields about one qtl fodder. Branches more than 2.5cm in diameter are generally not lopped to avoid damage to trees. In some cases when a person lops a tree of another knowingly or by mistake he gives another tree of equal size to the actual right holder for lopping. Sometimes, if he does not agree to the offence the case is referred to the committee, which fines the offender. These trees are also used for exchange of produce. If some one is not in need of the produce in a specific year because of his cattle not being near his house, he gives it to another villager who in turn returns him the produce of his own tree in the next year.

In Jiskoon village, there is a big Mohru tree on which 20 families exercise right of lopping. Big branches of the tree have been permanently distributed among themselves. Each family thus has a right on selected branch/branches of tree and they lop only allotted branches according to fodder need. No one lops fodder from other's branches.

People have recognised the importance of trees especially that of Mohru and Kharsu for fodder. They themselves plant these trees wherever vacant land in forests, common land or agriculture fields is available for planting. Approximately 1,500 such trees have been reported to be planted during 1999 by the villagers without outside support and they have therefore enriched their fodder and forest resources.

There is a local method of planting these trees. Seeds of Kharsu and Mohru are collected during Sept-Oct and are sown by dibbling in protected places especially along boulders/stones where animal damage is likely to be low. Seedlings in these niches develop fast in comparison to open area where they remain stunted. These seedlings are allowed to grow for 4-5 years and then hedged at about 1.5-2 m height, covered with fresh cow-dung and a plastic sheet. These lifted with about 0.6m root system are planted in 1 m pits by maintaining the collar position of the seedling with the ground level. The survival rate of Mohru and Kharsu trees planted by this method by the villagers is reported to be very high i.e. upto 90%. Each family owns the right of lopping the newly planted trees in Govt. forest, village common land or own agricultural fields. Saplings on planting are trained by lopping the side branches and leaving one shoot to form the leader. These saplings become ready for regular lopping in 10 years time. On the natural death of the tree, it is replaced by the right holder family with the sapling of same tree species and maintains the future right of its lopping.

Fuel wood : People collect dried and fallen wood for meeting their firewood requirement. Firewood is collected during Oct-Nov. Each family collects about 100 bundles of firewood weighing about 20 kg each. Collected firewood is taken to the houses and is used during winters and thereafter. Fuelwood is collected freely and there is no regulated system of its collection and distribution.

Kail needles (Sotar) : Fallen Kail needles are collected by the villagers twice a year i.e. once in May-June and then in Oct.-Nov. These needles are used as bedding material in cowshed during monsoon season and winters. Each family collects around 20 bundles of Sotar (20 kg/bundle) each year. The Sotar used in cowsheds goes to agricultural fields as manure. Nearby Kail forests have also been reported to be permanently divided among the families for collection of Sotar. In some cases, if a family require more, it collects additional Sotar from other area with the consent of the concerned family in exchange of the same next season.

Guchhi : Guchhi a local name for *Morchella esculenta* is a precious mushroom, which grows locally in forests after the snow melt. Each family collects it from the forests without any restriction and there is no system on its collection. Each family normally collects around 1 kg of Guchhi in one season, though some families may have collections up to 3 kg in some seasons. Guchhi is locally sold to contractors at about Rs. 3000 per kg.

Medicinal herbs : Local forests are rich in medicinal herbs, over 30 of which are regularly collected by the villagers. This is the only forest produce collected under rights by the locals for sale. Important medicinal herbs of the area are Atish - *Aconitum heterophyllum* (sold at Rs. 1,000-1,200/kg), Rattanjot - *Potentilla* species (Rs. 150/kg), Karwi - *Picrorhiza kurrooa* (Rs. 120/kg), Meetha - *Cherophyllum* species (Rs. 60/kg), Dhup - *Jurinea* species (Rs. 45-50/kg), and Panja (Rs. 600/kg) and are exported from the area through middlemen. Each year people collect these herbs and sell to the contractors.

Annually about 4-5 truckloads of these medicinal herbs are collected and exported from Jakha Panchayat. Each family gets an annual income of around Rs. 5,000 from the sale of collected herbs.

Besides these products, villagers also get timber trees under timber distribution system once in five years for construction and repair of buildings. Trees are also sanctioned to the affected parties in case of natural calamities like fire and snow damage and also for funeral and religious purposes. FD has set rules and procedures for providing trees to the villagers under the existing timber distribution rights and concessions.

The system presented here has its roots in the 'Deota' (Village God) system, which exists in many remote villages of the State. Deota system is considered as the most important, powerful and influential village level institution for effective decision making on community issues. Singh and Sikka (1992) reported that in certain villages of Kullu District, power and influence of the local deity formed an integral part of social control. The role of village committees play in forest related issues is not exclusive but is a part of its overall coordination in all religious and social issues. People have a great faith in the decision making and conflict resolution of the committees, which are neither political nor administrative bodies.

Presently applied Joint Forest Management is believed to have evolved for the management of degraded forests with the collaboration of local village communities (Khare, 1993). The system of Dodra-Kwar is in the rich forest resource area and appears to be a result of strong social bonding, increased inter-dependence of peoples in remotely situated areas and their increased dependence on surrounding forest resources for sustenance and support.

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SUMMARY

Paper presents a case of villager's traditional initiatives in the management and regulated use of Non-Timber Forest Products (NTFPs). The system has roots in 'Deota' (Village God) system being practiced in the remote villages of Himachal Pradesh in which collection, distribution and even enrichment of the forest products is governed by the practice established long back when the present day form of Joint Forest Management was not initiated. Collection of products from the government forests is permanently distributed by trees/area whereas for some others annual distribution is made among the families and there are least conflicts in their regulated use.

सहभागी वन प्रबन्ध में पारम्परिक पहल – दोदरा – क्वार (शिमला, हि०प्र०) अनुभव

आर०सी० धीमान

साराशं

इस अभिपत्र में गैर प्रकाष्ठ वनोपजों के प्रबन्ध और विनियमन में दिए जाने वाले एक गांव की पारम्परिक पहल को प्रस्तुत किया गया है । इस प्रणाली की जड़ें देवता प्रचलन तक पंहुची हुई हैं जिसे इस राज्य के सुदूरस्थ बसे गांवों में वनोपजों के संग्रह, वितरण यहां तक कि इन्हें सम्पन्नतर बनाने के लिए भी व्यवहार में लाया जाता है जो उन प्रथाओं से शासित है जो बहुत प्राचीन समय में स्थापित हो चुकी थी जब आंज का संयुक्त वन प्रबन्ध जन्म भी नहीं ले पाया था । सरकारी वनों से इकट्ठा की गई उपज को परिवारों में स्थायी रूप से वृक्ष/क्षेत्रवार बांट दिया जाता है, जबकि कुछ अन्य प्रथाओं में उनका वार्षिक वितरण परिवारों में किया जाता है और उनके विनियमित उपयांग में बहुत ही कम झगड़े-टंटे खड़े होते हैं ।

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IMPACT OF VAM INOCULATION ON SOME SEMI-ARID TREE SPECIES

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Introduction

Vesicular-Arbuscular Mycorrhizae (VAM) fungi are beneficial to plants in many ways such as mineral cycling, tolerance to adverse conditions and to develop resistance against soil borne pathogens. In arid and semi-arid areas of Rajasthan, the soil is poor in nutrients like nitrogen and phosphorus. In such conditions, VAM fungi play a key role to increase absorption area through extramatrical hyphae, resulting in increase of uptake of nutrients, water and enhancement in plant growth. VAM fungi occur in most of the ecosystems including sand dunes, arid and semi-arid regions. Large numbers of trees, shrubs and grasses are highly dependent on VAM fungi. It has been proved that plants like, *Prosopis cineraria, P. juliflora, Acacia jacquemonti, A. senegal, Capparis decidua, Azadirachta indica, Euphorbia caducifolia* and *Calotropis procera* are highly mycorrhizal in natural habitats (Srivastava, 1992). The perennial grasses like *Cenchrus ciliaris, C. setigerus* and *Lasiurus sindicus* are well suited for desert ecosystem and show high degree of dependency on VA-endophytes (Srivastava and Chandel, 1987). The important contribution was made on growth response through mycorrhizae by Kormanik *et al.* (1977); Thapar *et al.* (1985); Mukherji and Jagpal (1987); Behl (1990); Kandaswamy *et al.*, (1987); Reena and Bagyaraj (1990b); Misra *et al.* (1995); Srivastava (1992); Vyas (1988). In the present study, an experiment was laid out to assess the growth response, biomass and percentage of infection through VAM inoculation on selected tree species of semi-arid regions.

Material and Methods

The experiment was laid out in the year 1997-98 at Grass Farm Nursery, Jaipur (Rajasthan). The species were :

1. *Cordia myxa*,
2. *Artocarpus integrifolia*,
3. *Dalbergia sissoo*,
4. *Pongamia pinnata*,
5. *Mangifera indica* and
6. *Alestronia* sp.

There were two treatments viz., Inoculated (I) and Uninoculated (UI) and

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20 replications. Each replication was containing one seedling. The one month old seedlings were selected for the study. Consortium inoculum (dominance of *G. fasciculatum*) of VAM fungi containing 400-500 spores/pot were given by adopting side banding method. Watering and weeding was done whenever found necessary.

Processing of roots was done by adopting procedure for staining by Phillips and Hayman (1970), and percentage root colonization was assessed by the method as given by Giovennetti and Mosse (1980). Root pieces 1 cm long were selected at random from stained sample and mounted on microscopic slides in groups of 10 pieces. Presence of infection in the form of vesicles, arbuscules and hyphae was calculated by using the formula :

$$\text{Percentage of} = \frac{\text{No. of root segments infected}}{\text{Total no. of root segments examined}} \times 100$$

Finally observations were recorded on shoot height (cm), root length (cm), biomass (g) and VAM colonization (%). The percentage of increase in shoot height, root length, biomass and VAM colonization was calculated by using following formula :

$$\text{Increase (\%)} = \frac{\text{Inoculated-Uninoculated}}{\text{Inoculated}} \times 100$$

Results and Discussions

It is apparent from the Table 1 that VAM inoculated seedlings of all the tree species performed better in term of shoot height, root length, biomass and percentage of colonization. Shoot height (Table 1 column 1c) invariably increased between 11.2 to 32.2 per cent depending on the species. The maximum (32.2%) percentage of shoot height was recorded in *A. integrifolia* and minimum (11.2%) in *Mangifera indica*. The maximum shoot height (104.6 cm) was noticed in *Alestronia* sp. followed by *Mangifera indica, Cordia myxa, Dalbergia sissoo, A. integrifolia* and *Pongamia pinnata*. Variation in root length (Table 1 column 2 a & b) clearly showed that inoculated seedlings were having better root system as compare to un-inoculated seedlings. The per cent increase of root length (Table 1 column 2c) ranged between 25.0-35.7 per cent. The maximum root length increase was recorded in *Cordia myxa* and minimum in *A. integrifolia*. In case of biomass the data Table 1, column 4 clearly shows that biomass was increased due to inoculation of VAM in all the selected tree species. It was ranged between 4.7-31.1 per cent. The maximum biomass increased in *Alestronia* sp. and minimum in *A. integrifolia*. The percentage of VAM colonization was recorded maximum in *Alestronia* sp. (65%) and minimum (36%) in *A. integrifolia* as compare to un-inoculated seedlings. The maximum (55.0%) increase in VAM colonization was noticed in *A. integrifolia* and minimum (28.6%) in *M. indica*.

The observation clearly showed that VAM inoculated seedlings performed better then un-inoculated in all the parameters studied. The following conclusions were made by the present study.

1. All the trees species studied during experimentation showed dependency towards VAMF.

2. VAM inoculated seedlings of all the selected tree species performed better in term of shoot height, root length,

Table 1

Effect of VAM on biomass of different tree species (VAM inoculated and uninoculated) after one year old seedlings

Tree Species	Av. Shoot Height (cm) (1)			Av. Root Length (cm) (2)			Av. Biomass (g) (3)			VAM Colonization (4)		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
	UI	I	Increase (%)	UI	I	Increase (%)	UI	I	Increase (%)	UI	I	Increase (%)
Cordia myxa	49.4	62.4	20.8	6.8	10.8	33.3	4.4	5.3	4.77	20	42	52.3
Artocarpus integrifolia	38.2	56.4	32.2	7.2	9.6	25.0	4.0	4.8	16.60	16	36	55.5
Dalbergia sissoo	52.3	68.2	23.3	8.5	12.6	30.6	4.8	6.0	20.00	32	58	44.8
Pongamia pinnata	44.4	56.2	20.9	7.4	11.2	35.7	4.2	5.1	17.60	28	46	39.1
Mangifera indica	68.2	76.8	11.2	8.8	12.6	30.1	5.1	6.2	17.70	30	42	28.6
Alestronia sp.	82.6	104.6	20.4	18.3	23.8	23.1	12.8	18.6	31.10	42	65	35.4

biomass and percentage of VAM colonization.

3. In nursery, VAM inoculation can play a vital role in producing quality seedlings, reducing rotation period and minimizing the use of inorganic fertilizers.

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SUMMARY

Use of biofertilizer particularly VAM fungi has a great importance in forestry as it provides minerals, wide absorption area of root zone, water uptake and tolerance to water stress conditions etc. Rajasthan covers about 61% of the geographical area of the total desert area of the country. In these harsh conditions, VAM fungi can play a significant role in survival of plants. In the present study some economically important tree species of Jaipur region namely *Cordia myxa, Artocarpus integrifolia, Dalbergia sissoo, Pongamia pinnata, Mangifera indica* and *Alestronia* sp. were selected for the study. VAM inoculated seedlings of above tree species performed better in term of shoot height, root height, biomass and percentage of colonization. The shoot height increase was maximum (32.2%) in *A, integrifolia* and minimum (11.2%) in *Mangifera indica*. The other parameters were also found better then uninoculated plants.

कतिपय अर्द्ध–शुष्क वृक्ष जातियों पर वैम टीकाकरण का प्रभाव

के॰के॰ श्रीवास्तव, वी॰ मोहन व नीलम वर्मा

सारांश

जैवउर्वरकों विशेषत: वैम कवकों के उपयोग का वानिकी में बड़ा महत्व है क्योंकि इससे जड़ क्षेत्र को अवशोषण करने का विस्तृत क्षेत्र, खनिज, जल उद्ग्रहण और जल की कमी के दबाव के प्रति सह्यता आदि मिल जाते हैं । राजस्थान में देश के कुल मरूभूमि क्षेत्रफल का लगभग 61% क्षेत्र आता है । ऐसी कठिन दशाओं में पेड़–पौधों की अतिजीविता में वैम कवक महत्वपूर्ण भूमिका निभा सकते हैं । प्रस्तुत अध्ययन में जयपुर क्षेत्र की आर्थिक महत्व वाली कुछ वृक्ष जातियों अर्थात् *कोर्डिया मिक्सा, आर्टोकार्पस इंटिग्रीफोलिया, डलबर्गिया सिस्सु, पोंगामिया पिन्नाटा, मैंगीफेरा इण्डिका* और *एलस्ट्रोनिया* की जाति को अध्ययनार्थ चुना गया । ऊपर बताई जातियों के वैम टीका लगाए पौधों की सक्रियता, प्ररोह की ऊंचाई, जड़ों की लम्बाई, जैवपुंज और उपनिवेशीकरण प्रतिशत की दृष्टि से ज्यादा अच्छी पाई गई । प्ररोह की ऊंचाई में वृद्धि सबसे ज्यादा (32.2%) *आ॰ इंटिग्रीफोलिया* में और सबसे कम (11.2%) *मैंगीफेरा इण्डिका* में होती देखी गई । अन्य परिमाप भी गैर टीका लगाए पौधों की तुलना में उनमें ज्यादा अच्छे रहते पाए गए ।

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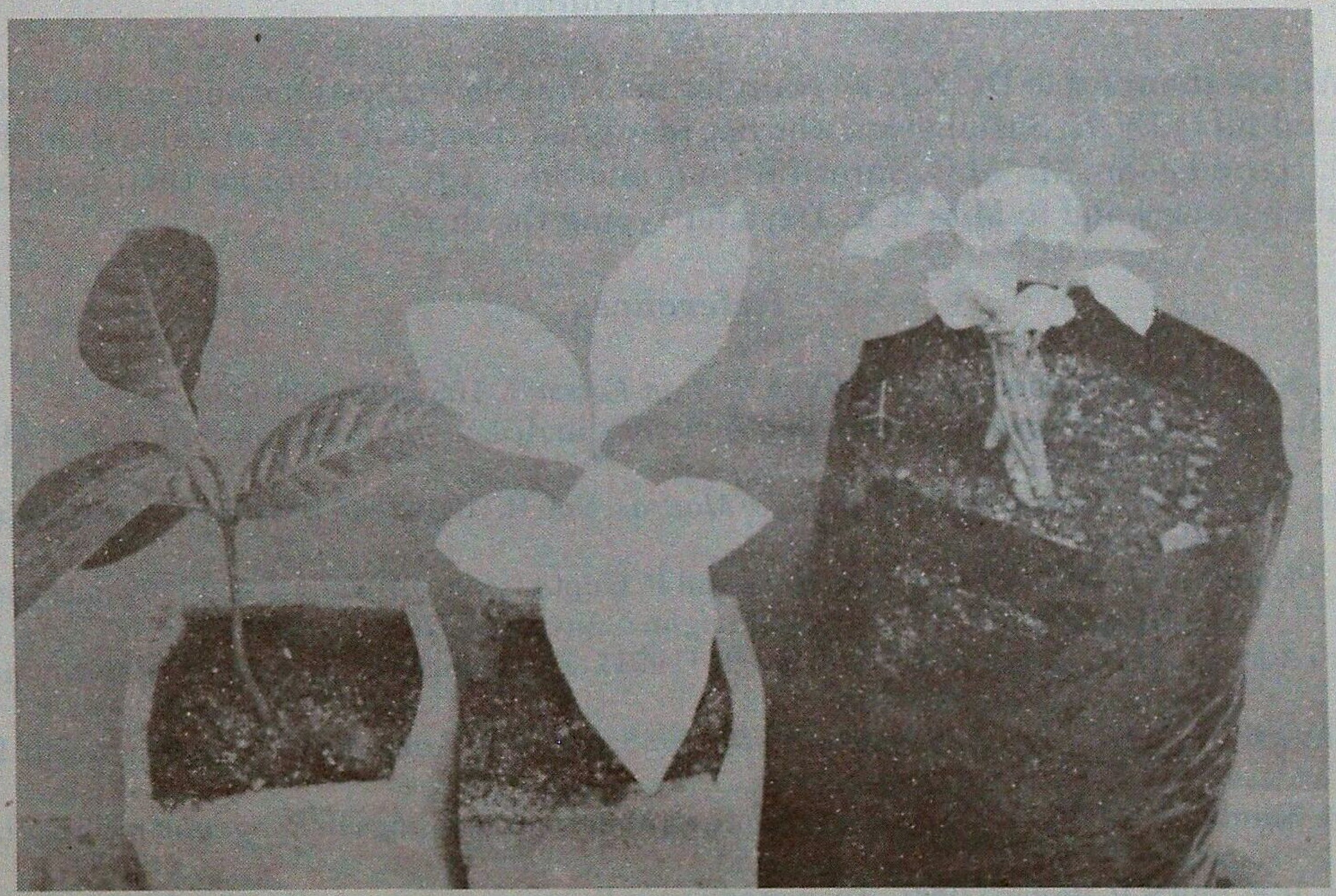
RESEARCH NOTES

(I)

OCCURRENCE OF MONO- AND POLY-EMBRYONIC ALBINO SEEDLINGS IN *MADHUCA BOURDILLONII* (GAMBLE) RAIZADA

Polyembryony is a phenomenon of occurrence of more than one embryo in a seed resulting in development of more than one seedling from a seed (Maheshwari, 1974). Polyembryony has been reported for several native tree species, like *Acacia nilotica* (Dobriyal and Bagchi, 1990; Kumar *et al.*, 1991), *Azadirachta indica* (Singh *et al.*, 1995), *Bombax ceiba* (Venkatesh and Emmanuel, 1978), *Butea monosperma* (Shrivas and Bajpai, 1990), *Pongamia pinnata* (Purohit and Jamaluddin, 1987), *Pterocarpus marsupium* (Shrivas and Bajpai, 1990), *Commiphora wightii* (Gupta *et al.*, 1996) and *Tectona grandis* (Dabral, 1977). Through this communication, polyembryony is being reported for the first time in *Madhuca bourdillonii*

Fig. 1



Seedlings of *Madhuca bourdillonii*
(a) Normal Seedling; (b) Albino Seedling; (c) Triple albino Seedling

(Gamble) Raizada. It is a medium sized tree belonging to the family Sapotaceae. It is endemic to Western Ghats of Kerala. It grows in Arienkavu and Shendurni valleys of the Western Ghats of Kerala upto an altitude of 330 m above mean sea level (Gamble, 1956).

Seeds of *M. bourdillonii* were collected during May 1997, from trees grown in the Government Guest House (Ramanilayam) compound in Thrissur, Kerala. A germination study was conducted using 100 seeds. The seeds showed characteristic hypogeal germination. Of the 86 germinated seeds, 75 were normal seedlings (Fig. 1a), 10 produced albino seedlings (Fig. 1b) and one produced triple albino seedlings (Fig. 1c). The green seedlings had normal growth whereas all albino seedlings (including polyembryonic) died within two weeks of germination.

According to Maheswari (1974) polyembryony is of two types, i.e., true polyembryony and false polyembryony. In true polyembryony, the additional embryos arise within the embryosac, either by budding or cleavage of the zygotic proembryo, or from the synergids and antipodal cells. The embryos may also originate from the cells of the nucellus or integument. On the other hand, in false polyembryony, supernumerary embryos may arise from different embryo sacs growing in the same nucellus or by fusion of two or more nucelli with independent embryo sacs. In *M. bourdillonii*, the triple seedlings probably evolved as a result of cleavage of the zygotic embryo.

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(II)

EFFECT OF GIBBERELLIC ACID (GA_3) ON GERMINATION OF *GIVOTIA ROTTLERIFORMIS* GRIFF., SEEDS

Introduction

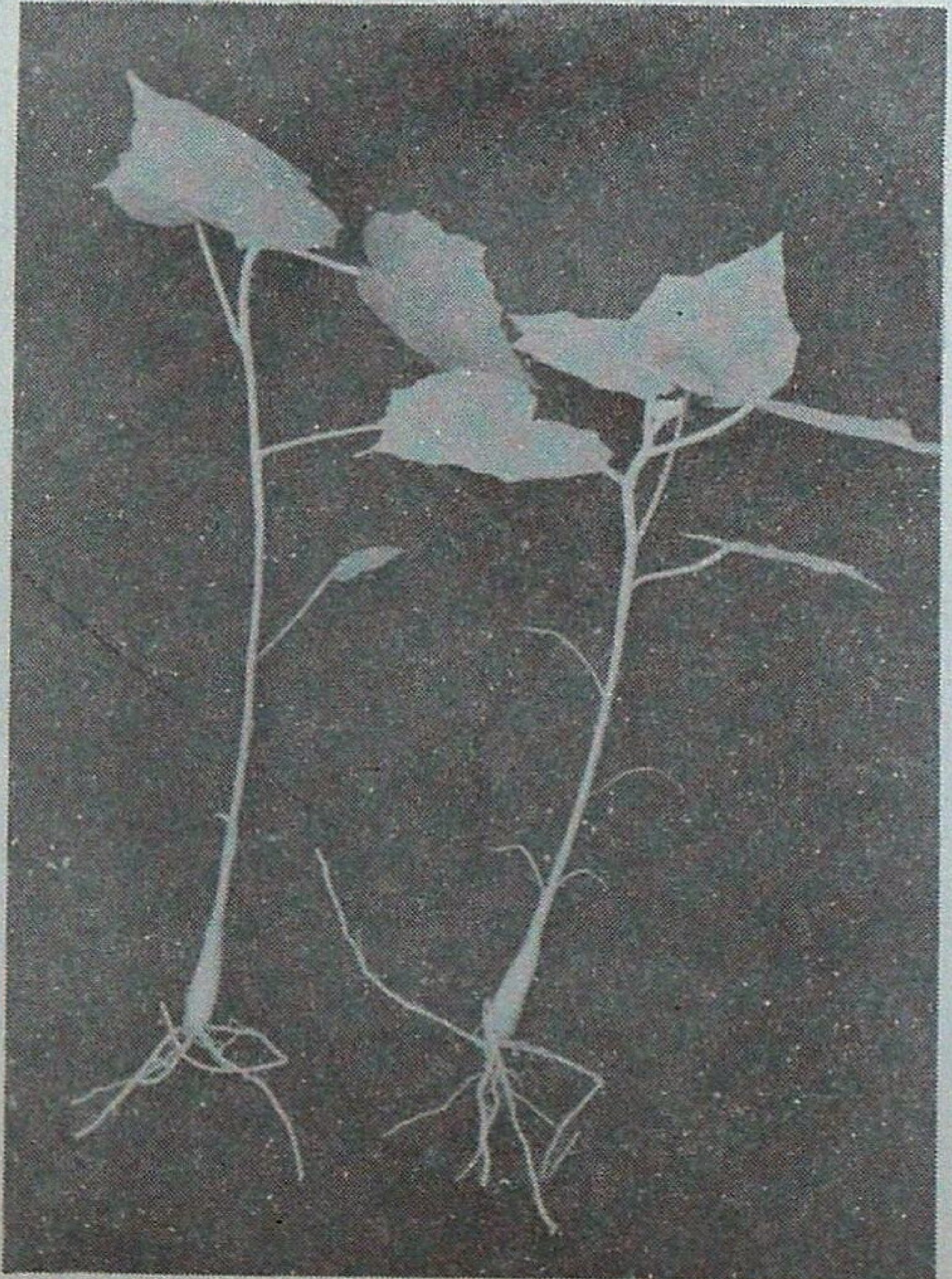
Givotia rottleriformis is a moderate sized tree occasionally found in dry deciduous forests of Andhra Pradesh. The trees are very conspicuous with large leaves, dense woody, white beneath. The wood is white, exceedingly light, very soft but even grained and used for making toys, trays, carved figures, imitation fruits and other fancy articles which are lacquered and painted. The wood is also useful in making boxes, panels, catamarans and other purposes where lightness is an advantage. The wood is fairly durable. Seeds yield oil, which is valuable for lubricating machinery. (Khan, 1953). The tree provides livelihood to toy making artisans in Nirmal town of Adilabad District and Kondapalli village in Krishna District of Andhra Pradesh.

The trees are becoming extinct due to over exploitation by virtue of its above uses coupled with poor natural regeneration. The fleshy seeds are readily preyed by sheep and goat and are also edible and eaten by man (Murthy, 1992). Propagation by seed sowing by various pre-treatment methods is also not seemingly good. Rooting of stem cuttings with various root inducing hormones is also a partial success. Propagation by seed is equally difficult due to presence of phenols and flavinoides which contribute to dormancy. Therefore, germination trials were conducted with GA_3 in Regional Forest Research Centre, Rajahmundry, Andhra Pradesh with seeds collected from natural stands available in Kondapalli area of Krishna District.

Material and Methods

The seeds were two year old and the outer 2 hard coverings were removed mechanically. The naked cotyledons that are covered by thick layers were pre-treated

Fig. 1



Seedlings of *Givotia rottleriformis*

Table 1

Germination of Givotia rottleriformis as influenced by different concentrations of GA_3 and intervals of pre-treatment

GA_3 Conc. (ppm)	Duration of pre-treatment (hrs)	No. of seeds treated	No. of seeds germinated	Time taken for germination (days)	Germination (%)
500	24	20	1	14	5.00
	72	30	3	12	10.00
1000	24	20	5	14	25.00
	72	30	10	12	33.33
2000	24	20	5	12	25.00
	72	30	12	10	40.00
Control	24	20	—	—	—
(Distilled Water)	72	30	—	—	—

with GA_3 of various concentrations and various intervals. A stock solution of 2000 ppm of GA_3 is prepared by dissolving 1 g in little quantity of propanol and made the volume to 500 ml with distilled water. From this stock solution 1000, 500 ppm were prepared by following serial dilution technique. The seeds were pre-treated in the known concentrations of GA_3 for 24 and 72 hours. The pre-treated seeds were sown in sand media in lath house and were observed for germination.

Results and Discussion

Germination commenced after 10 days of sowing and continued upto 40 days and thereafter no seedling was emerged. The germination of seeds as influenced by different concentrations of GA_3 for 24 and 72 hours is presented in the Table 1.

It is observed from the table that both the concentrations (1000 ppm and 2000 ppm) exhibit the same per cent of germination (25%), but the germination is quicker (by 2 days) in case of 2000 ppm when compared to 1000 ppm, in 24 hours treatment.

Quicker and higher per cent of germination (40%) is noted with 2000 ppm concentration, when the seeds are treated for 72 hours. In both the cases of duration (24 and 72 hours). Germination per cent is poor with lower concentration (500 ppm) and germination is completely absent in control. It is noted that, in all the concentrations, germination per cent is increased as the duration of the pretreatment is increased. Therefore, it may be preferable, that higher concentrations of GA_3 when soaked for longer periods may give better results.

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(III)

A NEW RECORD OF ROOT BORER ON *ALBIZIA LEBBEK* IN TAMIL NADU

Albizia lebbek (L.) Benth., a fast growing timber tree species, is being promoted on a large scale in social forestry and agroforestry programmes has been reported to be infested by a number of insect pests (Hegde and Relwani, 1987; Pillai *et. al.*, 1991).

Further studies carried out on the insect pests of *A. lebbek* has brought to light a serious problem of root borer, which kills the saplings and young trees outrightly in the plantations (Fig.1A). This problem was noticed in *A. lebbek* stands raised in certain localities of Tamil Nadu. The insect species causing the problem was identified as *Sternocera chrysis* (Fabricius) (Coleoptera : Buperstidae). This is the first record of this pest on *A. lebbek* in India. Some other species of the same genus (*S. castanea, S. aequisignata* and *S. ruficornis*) have also been reported as key pests of *Acacia* spp. (*A. senegal, A. seyal* and *A. mangium*) in Sudan and Thailand (Jamal, 1994; Hutacharern and Chodumrongkul, 1989).

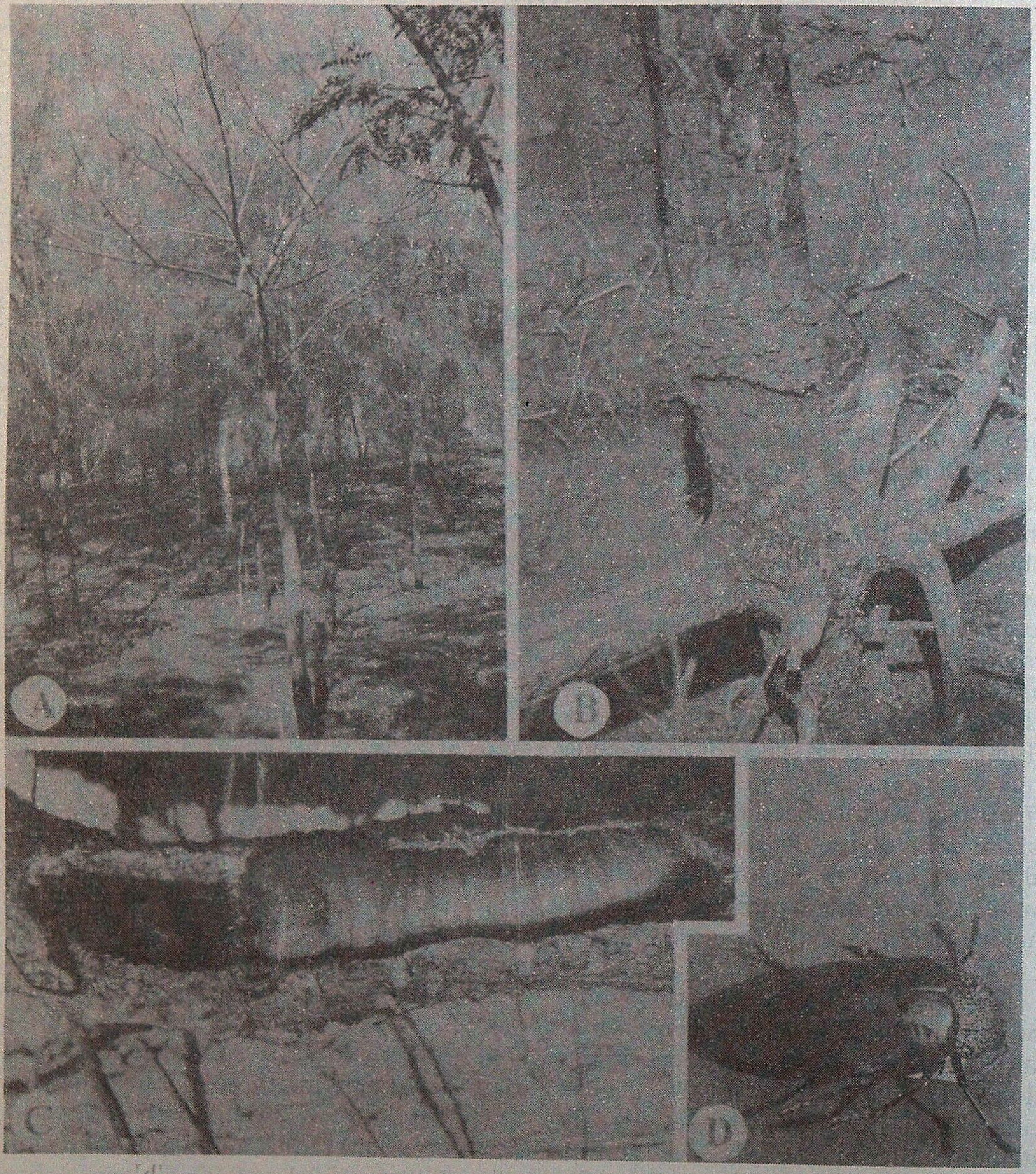
The adult of this jewel beetle is dark brown with shiny metallic green colored head (Fig. 1D). The female lays eggs in the soil near the roots of the plant. The grub is creamy white with brownish hair sparsely distributed all over the body. Well grown-up grub measures about 6-8 cm (Fig. 1C). The grub feeds on the tap root as well as lateral roots by making grooves like excavations which are filled with coarse of wood particles and fibres. Continuous feeding by the grub results in total destruction of the tap root (Fig. 1C) and subsequently the affected saplings/trees succumb to the attack of the pest. The grub pupates in the soil in a thick earthen cocoon. The life cycle of this pest is annual. Sometimes, the grub feeds on the bark of the main stem at the collar region (Fig. 1B) below the ground level at the junction of the stem and root and girdles the tree. Most of the trees were found infested by a single grub. A maximum of three grubs could also be recovered from one tree. Infestation of this pest can be detected by noticing pale colour of the leaves in the beginning followed by gradual wilting and total drying of plants. The pest attack occurs during the dry months (May and June).

Suggested Management

- Conducting pest surveillance in the plantations at a regular intervals, particularly during dry summer for detecting the incidence of the pest by observing the wilting symptom in plants.

- Raking the soil around the affected trees, making three to four holes to a depth of 20-25 cm with help of a crowbar or stick and application of 3-5 liters of 0.1 to 0.2% Chlorpyriphos 20 EC pesticide was found effective in killing the grubs *in-situ* and helped the plant to recover from this problem.

Fig. 1 (A-D)



A. Young trees killed by grub
B. Girdling of stem
C. Grub *in-situ*
D. Adult *Sternocera chrysis*

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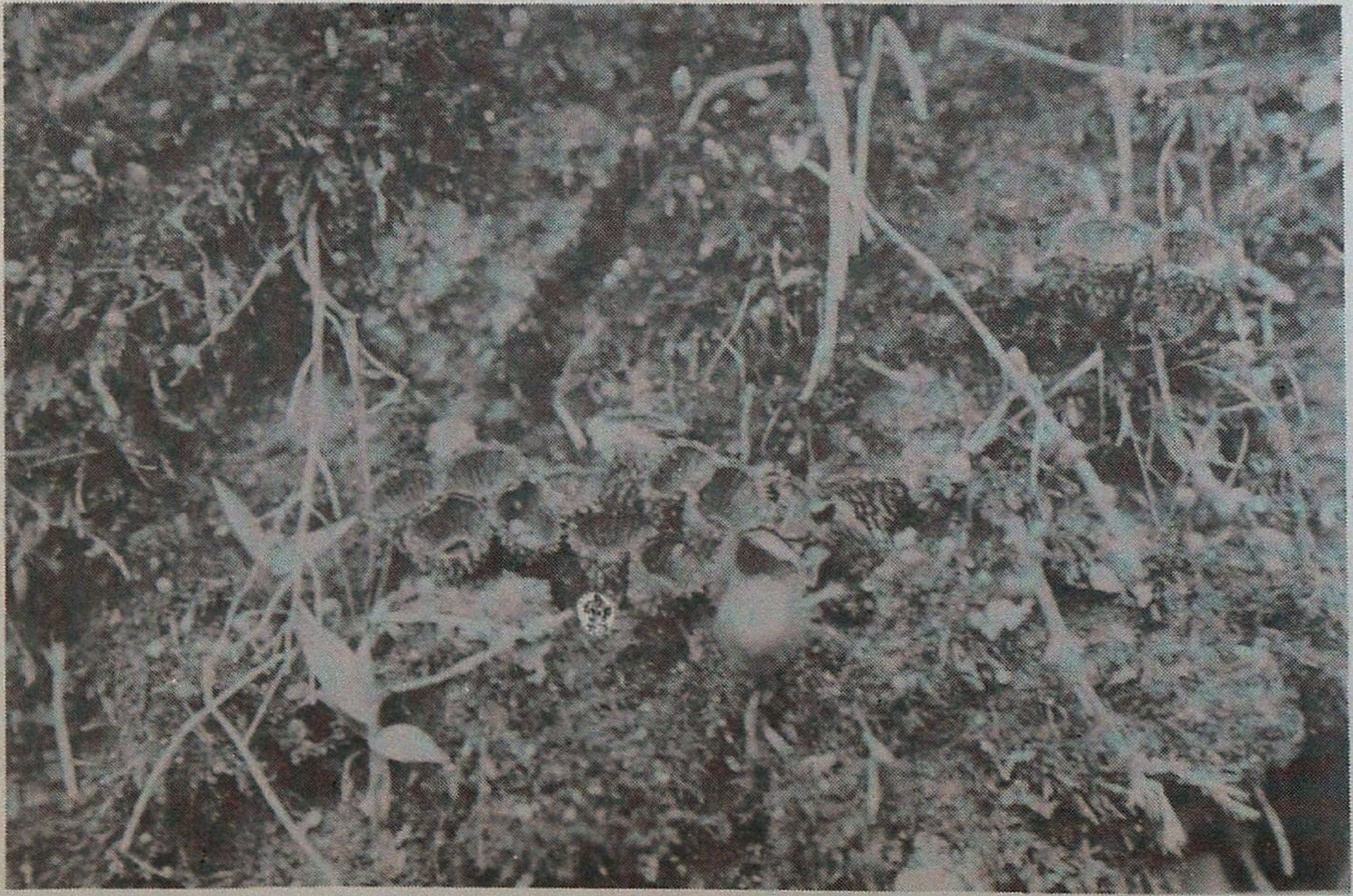
(IV)

CYATHUS AND *GEASTRUM* - AN ADDITION TO DARJEELING MYCOFLORA

The Darjeeling Himalaya (consisting of three hill sub-divisions of the district of Darjeeling) a segment of the Eastern Himalaya is an interesting region *per se* (Biswas and Chakraborty, 1989). The hill area is around 2436.55 km^2 or 77% of district area. Altitudinal variation over the region ranges from 150 m to more than 3000m presenting widely differentiated topographical condition (Chakraborty, 1997). The Himalayan ecosystem is known for its richness in biodiversity (Chakraborty, 1997). Very few works have been undertaken regarding the biodiversity of macrofungi of this area (Bilgrami *et al.*, 1991).

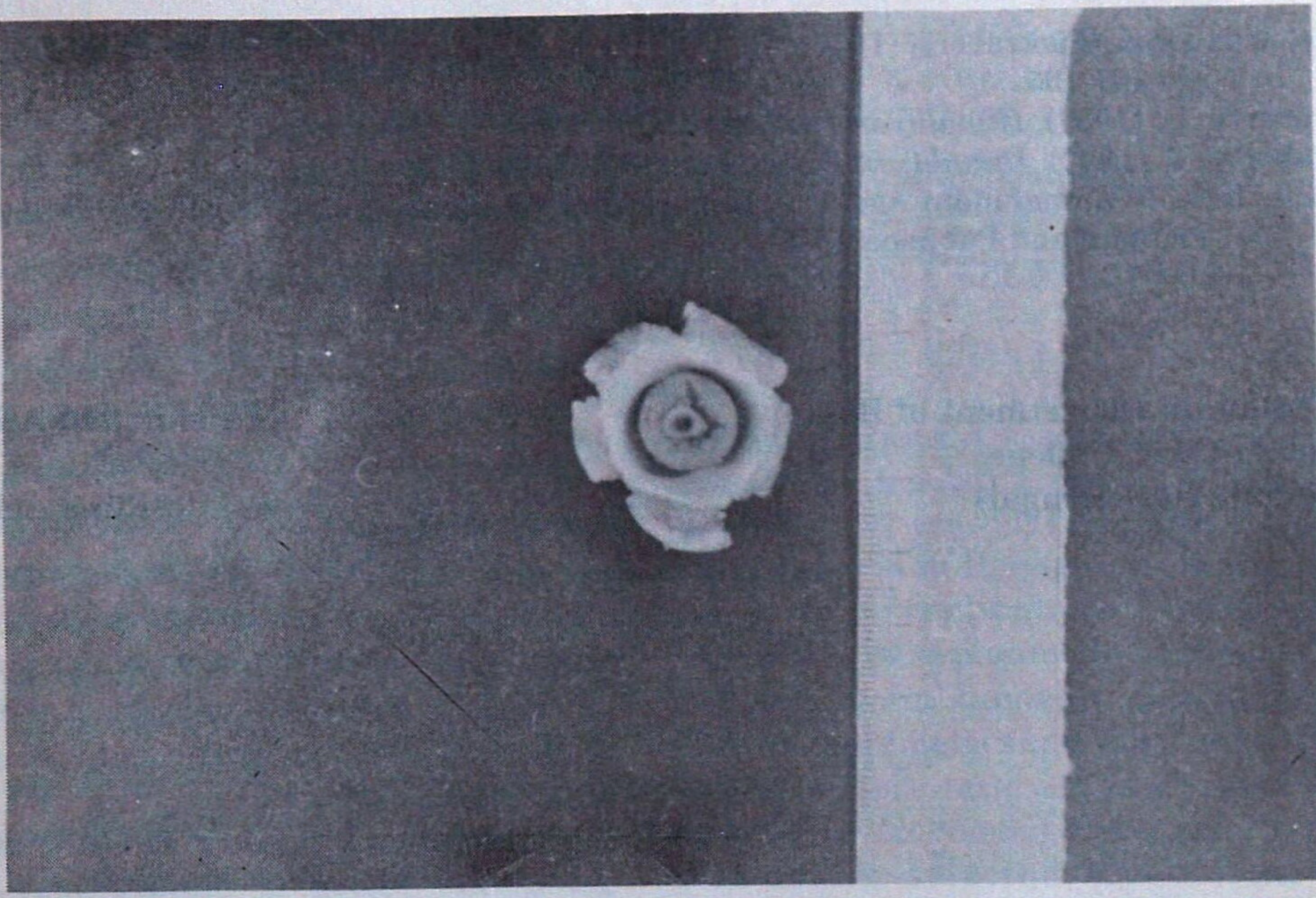
During a mycological survey of macrofungi at the adjoining area of Darjeeling town, several macrofungi from different groups were collected. Among them these two fungi, *Cyathus* Haller ex Pers., Gasteromycetes : Nidulariales and *Geastrum* Pers., Gasteromycetes : Lycoperdales, has not yet been reported

Fig. 1



Carpophore of *Cyathus* sp. Haller ex Pers.

Fig. 2



Carpophore of *Geastrum* sp. Pers

from this area (Bilgrami *et al.*, 1991). A brief description of this two fungi is given below :

Cyathus sp. : The fruit body (Carpophore) is small globet, grey, and elegantly grooved inside. The outer surface is coated with stiff brown hairs. The inner cavity is lead coloured, sulcate lengthwise. In the inside of the cavity presence of periodioles which are whitish-grey, circular, compressed, umbillicate and diameter varies from 1.5-2.0 mm, attached by a white, elastic funiculus. The fruit body are 10-13 mm high and 8-10 mm wide. During immature condition remains covered by a thin white membrane (Fig. 1). Spore white, elliptical, smooth, 18-22 x 8-12 microns. The voucher specimen has been deposited in the Mycological Herbarium of Darjeeling Government College (DGC/MP/MF 068).

Geastrum sp. : The fruit body (Carpophore) is subglobose, 1.5-3 cm in diameter. Exoperidium fleshy, opening into 5-8 triangular lobes, fairly equal, olive brown outer (Fig. 2) and light brownish inner side, with a thick fleshy stratum which breaks up and disappears except for the central part where a sort of cup forms at the base of endoperidium, which is globose 1.3-2 cm in diameter, light brown, sessile, membranous with lighter apical ostiole, conical, fibrillose-fringed. Immature glabba whitish, on maturity olive-ochre, powdery. Spores are brown, globose, warty, 9-12 microns. The voucher specimen has been preserved in the Mycological Herbarium of Darjeeling Government College, Darjeeling (West Bengal) (DGC/MP/MF 074).

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(V)

INTRODUCTION OF *PAULOWNIA FORTUNEI* IN AGROFORESTRY FARMING SYSTEMS UNDER RAINFED CONDITIONS AT DOON VALLEY, INDIA

Introduction

Paulownia is an ideal agroforestry tree which can be integrated with shade tolerant trees, shrubs and crops (see cover photo). It is mainly recommended for intercropping with agricultural crops (Singh *et al.*,2001). *Paulownia* has a deep root system in which over 75% of the roots are distributed between 40-100 cm from the ground level. Such root system is better suited for intercropping with agricultural crops as the root system of most agriculture crops lies in the top 30 cm depth. *Paulownia* roots therefore, have less competition for nutrients and moisture with those of agriculture crops. *Paulownia* sheds large quantity of nutrient-rich leaves during winter which decompose quickly and add nutrients to the soil (Anon., 1988; Singh and Arora, 1997, 1999).

Material and Methods

The study was conducted in the farmer's field in Selakui village of Sahaspur block, District Dehra Dun (Uttaranchal). The *Paulownia fortunei* as tree component of the agroforestry system was establish during December, 1997 with crop sequence of wheat and maize. Crops were grown in association with *Paulownia fortunei* as per the package of practices recommended for the area and crop varieties. Plantation of *Paulownia fortunei* seedlings of similar size was done in existing crop of wheat during early winter season (December) at spacing of 5 m x 6 m in Randomized Block Design with four replications. One-year old seedlings were planted in 60 cm deep holes having 30 cm diameter. Observations on growth parameters and biomass production of trees were recorded every year in the month of November-December from ten randomly selected trees from each replication leaving border lines. Crop growth and yield was recorded as per the season.

Results and Discussion

Performance of *Paulownia fortunei* on farmers' field under rainfed conditions was excellent. It out performed the widely grown *Populus deltoides* (G-48) over the last three years (1998-2000) at the present site. Data indicated (Table 1) that the survival of *Paulownia* plants was higher (96%) than the Poplars (35%) at the end of the third growing season. The species also recorded 84% survival in bouldery riverbed land of Doon Valley (Singh and Arora, 2000). However, in general all the growth parameters of *Paulownia* viz. height, collar diameter, diameter at breast height (DBH) and crown size etc. were comparatively higher than Poplar. The maximum Current Annual Increment (CAI) was observed in

Table 1

Growth performance of P. fortunei vis-a-vis Populus deltoides (G-48) in Agroforestry Systems on farmers' field under Doon Valley conditions

Growth characteristic	*Paulownia fortunei*					*Populus deltoides* (G-48)				
	Initial	1998	1999	2000	Av.	Initial	1998	1999	2000	Av.
Height (m)	3.0	3.7	5.6	7.3	5.5	2.8	3.0	5.5	6.8	5.1
Collar diameter (cm)	4.7	6.0	12.1	16.1	11.4	1.9	2.2	5.9	8.7	5.6
DBH (cm)	3.1	3.3	7.4	12.7	7.8	1.3	1.6	4.2	7.1	4.3

Table 2

Biomass production (kg/tree) and crown size (m) of P. fortunei compared with Poplar (G-48) under Doon Valley conditions (Av. of 3 years)

Species	Crown Size	Leaf yield	Branchwood	Total biomass
Paulownia fortunei	3.31	4.86	8.39	13.25
Populus deltoides (G-48)	1.25	1.12	1.51	2.63
Increase over Poplar	2.06	3.74	6.88	10.62

the second growing season (1999) in both the species. It is obvious that in first year the total plant energy is invested for the development and establishment of under ground parts, hence the aboveground growth is limited. The maximum average annual growth increment of *Paulownia* was recorded in collar diameter (1.5 cm) followed by DBH (1.3 cm) and height (0.13 m) over Poplar.

Biomass of *P. fortunei* is the main component in a *Paulownia* Crop Intercropping (PCI) system. The quantity of *Paulownia* biomass reflects the productivity and the flow of materials and energy of the PCI system. Biomass production (fresh weight) of *Paulownia* and Poplar was investigated yearly and separately after planting out, and the total biomass was divided into two major components as leaf yield and branchwood. The proportion of biomass production of *Paulownia* as leaf yield, branchwood and total biomass were superior as compared to Poplar (Table 2). It was also observed that the average crown size of *Paulownia* was 165 per cent larger than Poplar therefore, the leaf and branchwood yield were three fold and four and half fold higher in *Paulownia* than Poplars respectively.

It is inferred from the discussion that the *Paulownia fortunei* tree can successfully be introduced in agroforestry systems as a multipurpose tree species under rainfed conditions of Doon Valley and similar areas. It performed better in growth and production over Poplar trees therefore it may play a vital role in meeting the demands of fuel, fodder, timber etc. of rural population. Even at the initial stage, the growth and biomass production differ significantly without any adverse effect on the crops by both the trees species.

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FOREST NOTES AND OBSERVATIONS

GREGARIOUS FLOWERING OF *DENDROCALAMUS STRICTUS* IN HARYANA

Gregarious flowering of *Dendrocalamus strictus*, the common Bamboo has been noticed in the Pinjore Forests of Panchkula District of Haryana. Bamboos in this region are of both natural and planted origin. The previous gregarious flowering was noticed in 1962.

The Haryana Shivaliks consist geologically of sandstone, sandrock and conglomerates and exhibit erosion of various forms and degrees. Soils vary from sandy loam to loam with colour varying from light brown to brown in upper layers to slightly dark brown in lower layers. The climate of area is subtropical, the higher elevations being comparatively cooler. The temperature varies from 2 to 3° C in January to 45° C in May. The average rainfall varies from 800 mm to 1200 mm.

The total area under Bamboo is around 1387.5 ha. The proportion of Bamboo is variable and many compartments contain a mixture of Bamboo with broad leaved species. On warmer aspects, the Bamboo

clumps are more scattered while on cooler aspects, the proportion of Bamboo clumps increases. Other associates of Bamboo are *Acacia catechu, Cassia fistula, Lannea coromandelica, Aegle marmelos, Anogeissus latifolia*, etc. Bamboo flowering has occurred over an area of 660.6 ha and the percentage of flowering varies from 5 to 85% in all the 9 different compartments. The process of flowering started in December 2000 and continued upto March 2001.

Normally there is a great demand for Bamboo seeds and the collection of fully ripe seeds from the superior clumps has already been started from this area and the proper storage conditions are maintained for longer viability of the seeds.

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From the Indian Forester - One Hundred Years Ago

THE
INDIAN FORESTER

August, 1901 (pp 418-419)

ROTATION AND POSSIBILITY IN SELECTION FORESTS

In Mr. Gleadow's very interesting article in the March Number of the *Indian Forester* on "Rotation and Possibility in Selection Forests", we are recommended to regulate the possibility by fixing the proportion of trees to be felled. The question at once arises - how is the proportion to be fixed ?

In the May Number we read that Dr. Schlich says, in speaking of the rotation in selection fellings, that the length of the rotation is determined by the quantity cut at each felling. I would enquire if this is not an inversion of the actual process. To take Dr. Schlich's example of coppice-with-standards, surely no author of a working-plan would lay down the rule "fell one standard out of four," unless the resulting rotation of 150 years was found to be the most suitable one. In other words, *the length of the rotation* must determine the proportion of trees to be felled.

In selection fellings, too, it would appear that some estimate of the average number of years in which one crop is replaced by the next, i.e., the rotation must form the basis of calculation, whether this period represents the actual age of a mature tree, or merely the average number of years in which a tree attains a certain girth. Mr. Gleadow concludes by calling this rotation "a paper one," which means, I take it, that he thinks it of no importance; but nevertheless if it be on the same paper that the all-powerful proportion is worked out, it is not to be lightly treated. Even if so much be granted, the step from Dr. Schlich's simple example to the fixing of the proportion in a regular high forest under the selection system is very great; for not only is the number of mature trees available at each felling not an obvious proportion of the crop, but we have also to obtain a satisfactory check on the cutting of smaller trees under Dr. Schlich's second and third laws of sylviculture. To the uninitiated a possibility by volume might appear a more hopeful affair. Further, to take the case of forests which are not regular, but from which, for sylvicultural reasons, an unfair proportion of the trees which will be mature at the next time of asking (class II) have been removed. Such forests are perhaps not unknown in the province of Oudh. At the next fellings age-class I will occupy too small an area, while age-class II will be in excess-if we aim at bringing about a normal distribution, considerable fellings must take place among the trees in age-class II, which are relatively more numerous than mature trees, areas being equal. Hence the proportion fixed for a regular forest will no longer hold, and it is difficult to see how a correct figure is to be arrived at without some of those "clawings and blazes", to avoid which appears to be one of the chief objects of the method under discussion.

At first sight, indeed, it would seem impossible to fix such a rule as "one oak out of four, and one beech out of three" without going to and fro in the forest; and I have no doubt that a further elucidation of the system advocated by Mr. Broilliard will be generally acceptable.

- F.F.R. Channer

LETTER TO THE EDITOR

To
Hony. Editor,
Indian Forester,
P.O. New Forest,
Dehra Dun (Uttaranchal)

***Sub* : Rooting response of root cuttings of some MPT species under low cost mist conditions.**
***Ref.* : Letter to the Editor - *Indian Forester*, 126 (11) : 1249.**

Sir,

Being the author of the subject paper, my comments on the letter referred above are under:

1. Replication is carried out to obtain a measure of experimental error and randomization ensures similar conditions to all the treatments. The subject experiment was conducted in a low cost mist environment, which provides almost similar conditions to all the treatments/replications. Though randomization was done, it was not felt necessary to mention the same in the article. For similar reasons, all treatments were uniformly replicated thrice.

2. All the seven MPT species, viz. *Albizia lebbek, Albizia procera, Azadirachta indica, Dalbergia sissoo, Dalbergia latifolia, Derris indica* and *Tectona grandis* have a rotation of 40 years or more. The age upto five years can be considered as juvenile phase. Since it was the first stage of experimentation, the objective was to attempt rooting of root cuttings in this phase. Had the objective been to standardize the effect of age on rooting, the exact age would have been mentioned.

3. Though rooting per cent recorded in *Tectona grandis* was low, the species has shown promising results in terms of number of roots, maximum root length and root weight.

4. Root weight also seems to influence the performance of rooted plants in the field and is an accepted as a standard parameter in evaluating the rooting response.

The authors have however noted the valuable suggestions of Shri T.R. Mahanta, IFS (Retd) for their further experimental work and are grateful for the encouragement extended.

Yours faithfully,
Sd./- Mohit Gera, IFS,
DFO, Seed Development Division,
SFRI, Jammu (J&K)

REVIEW

Productivity of Tropical Rain Forests of Karnataka by Dr. S.N. Rai, I.F.S. Published by M/s. Punarvasu Publications, P.B. Road, Dharwad (Karnataka). 138 Pages, 42, Figures, 14 Plates and 2 Maps. Price Rs. 360.00 or US $ 36.00.

The book deals with the seasonal rain forests of Western Ghats in India. The book comprises 9 Chapters, covering the vegetation, Profile diagrams, distribution of trees by diameter classes, species importance curve, bole, branch, leaf, twig, root, shrub, herb, above ground biomass, litter dynamics, nutrient cycling, leaf area index, soil and water litter analysis, allometric regressions on biomass production, estimates of primary productivity and other attributes of rain forests.

The book based on very large data set. About 434 trees, covering 12 species were considered for bole biomass 226 trees for branch and leaf biomass and 91 trees for root biomass estimations. The book contain 91 regression equations on various biomass related aspects. The strongest data are provided in respect of litter fall.

Chapter 7 contain the summary of the book, chapter 8 references and chapter 9 contain list of important species found in the study areas. It is a complete book on the subject.

The book will be useful reference tool to foresters, forestry scientists, researchers and those interested in rain forests.

- M.J.

GAZETTE NOTIFICATIONS

A.G.M.U.T. GAZETTE

Shri M.R.G. Reddy, IFS, Deputy Conservator of Forests is allowed to avail 61 days Half Pay Leave after handing over the charge of Dy. Conservator of Forests (Mill Division) and additional charge of Dy. CF (Utilization) with the direction that on expiry of leave he shall report for duty to the PCCF, Govt. of Arunachal Pradesh, Itanagar to join new place of posting.

Shri S.K. Raha, IFS, will handover the charge of Chief Conservator of Forests to Shri P.V. Savant, IFS (AGMUT : 1969), who in pursuance of has reported for duty under the Andaman and Nicobar Islands' Administration w.e.f. the forenoon of 14.05.2001.

Shri S. Senthil Kumar, IFS (AGMUT-98) (P) is posted as DFO, Mayabunder Division. He shall take over the charge as from Shri K. Ravichandran, IFS (AGMUT-96).

Shri K. Ravichandran, IFS (AGMUT-96) is transferred from DFO, Mayabunder Division to South Andaman Division. Shri K. Ravichandran after handing over the charge of DFO, Mayabunder to Shri S. Senthil Kumar, IFS (P), proceed on transfer to Wimberlygunj, South Andaman and shall take over the charge of DFO, South Andaman from Shri P. Subramanyam, IFS (AGMUT-92).

Shri P. Subramanyam, IFS (AGMUT-92), handover the charge of DFO, South Andaman to Shri Ravichandran, IFS and proceed on transfer and report for duty to the PCCF, Arunachal Pradesh.

ANDHRA PRADESH GAZETTE

Shri Y. Ram Mohan Rao, IFS (76), Conservator of Forests, State Trading Circle, Hyderabad on promotion to the rank of Chief Conservator of Forests is posted as CCF (Research and Training), O/o the PCCF vice Shri C. Sivasankara Reddy, IFS (76) transferred.

On transfer, Shri C. Sivasankar Reddy, IFS (76), Chief Conservator of Forests (Research and Training) is posted as CCF (JFM) reviving the cadre post. Consequently the ex-cadre post of Additional Prl. Chief Conservator of Forests (JFM) is abolished from the date on which the Member of Service takes charge of the post of Chief Conservator of Forests (JFM) on promotion.

Shri C. Muralidhar Rao, IFS, (76) General Manager, (Planning and Production), A.P. Forest Development Corporation, Hyderabad, on promotion to the rank of Chief Conservator of Forests his services from A.P. Forest Development Corporation are withdrawn and he is posted as CCF (Vigilance) O/o PCCF vice Shri C. Madhukar Raj, IFS (75) already transferred.

Shri L. Ch. Tirupelu Reddy, ACF working as Sub-Divisional Forest Officer, Nizamabad is transferred and posted as Sub-Divisional Forest Officer, Eleswaram of Kakinada Division vice Shri K. Pradeep, ACF, transferred.

Shri P.V. Chalapathi Rao, IFS (94), DFO, Nandyal (Wildlife), is transferred and posted as DFO, Visakhapatnam vice Shri Chiranjivi Chowdary, IFS (89) already on Central deputation.

Shri S.S. Sreedhar, IFS (92), DFO, Paloncha, is transferred and on transfer his services are placed at the disposal of General Administration (Vigilance and Enforcement) Department for appointment as Regional Vigilance and Enforcement Officer, Warangal, Vigilance and Enforcement Department in the existing vacancy on deputation basis.

Shri Qamar Mohd. Khan ACF/DFO Wildlife Management Division, Medak (on leave) is transferred and posted as ACF (Surveillance Cell) in O/o PCCF, Andhra Pradesh, Hyderabad in the vacancy caused due to posting of Shri S. Rama Rao, ACF as ACF , Nehru Zoological Park, Hyderabad.

Shri P.T. Rambabu, ACF/Sub-Divisional Forest Officer, Ichoda of Adilabad Division (on leave) is transferred and posted as Sub-Divisional Forest Officer, Koyyalagudem of Eluru Division of Rajahmundry Circle in the vacancy caused due to placing the services of Shri P. Bhushanam, ACF at the disposal of A.P. State Housing Corporation Limited to work as District Manager (Housing), Nalgonda District.

Shri P. Bhaskar Reddy, IFS (86), DFO, Nellore on promotion to the super time scale in the rank of Conservator of Forests is posted as Conservator of Forests State Trading Circle, Hyderabad vice Shri Y. Ram Mohan Rao, IFS (76) already transferred.

Shri K. Bhoopal Reddy, IFS (86), Director (Urban Forestry), HUDA, on promotion to the super time scale in the rank of Conservator of Forests, is retained in HUDA and posted as Executive Director, (Urban Forestry), HUDA, on the terms and conditions annexed to this order.

Shri T. Narasimhulu, ACF (waiting for posting orders) is posted as DFO, Flying Squad Division, Rajahmundry in the existing vacancy.

Smt. Shanti Priya Pandey, IFS (97), Sub-Divisional Forest Officer, Mugulu, Warangal (North) is appointed to the Senior time Scale of IFS in the scale of pay of Rs. 10,000-325-15,200/- with effect from 3.3.2001 and posted as DFO, Rajampet in the existing vacancy.

On return of Shri Ajay Kumar Naik, IFS (89), on completion of PG Diploma Course in "Remote Sensing - Application in Forest and Eco-System Management", at IIRS, Dehra Dun is posted as Dy. CF (GIS), O/o PCCF, A.P., Hyderabad vice Shri Anand Kumar Jha, IFS (92) transferred.

On transfer, Shri Anand Kumar Jha, IFS (92), Dy. Conservator of Forests (GIS), O/o PCCF, A.P., Hyderabad is posted as DFO, Warangal (South) vice Shri K.N. Benarji, IFS (86) already transferred.

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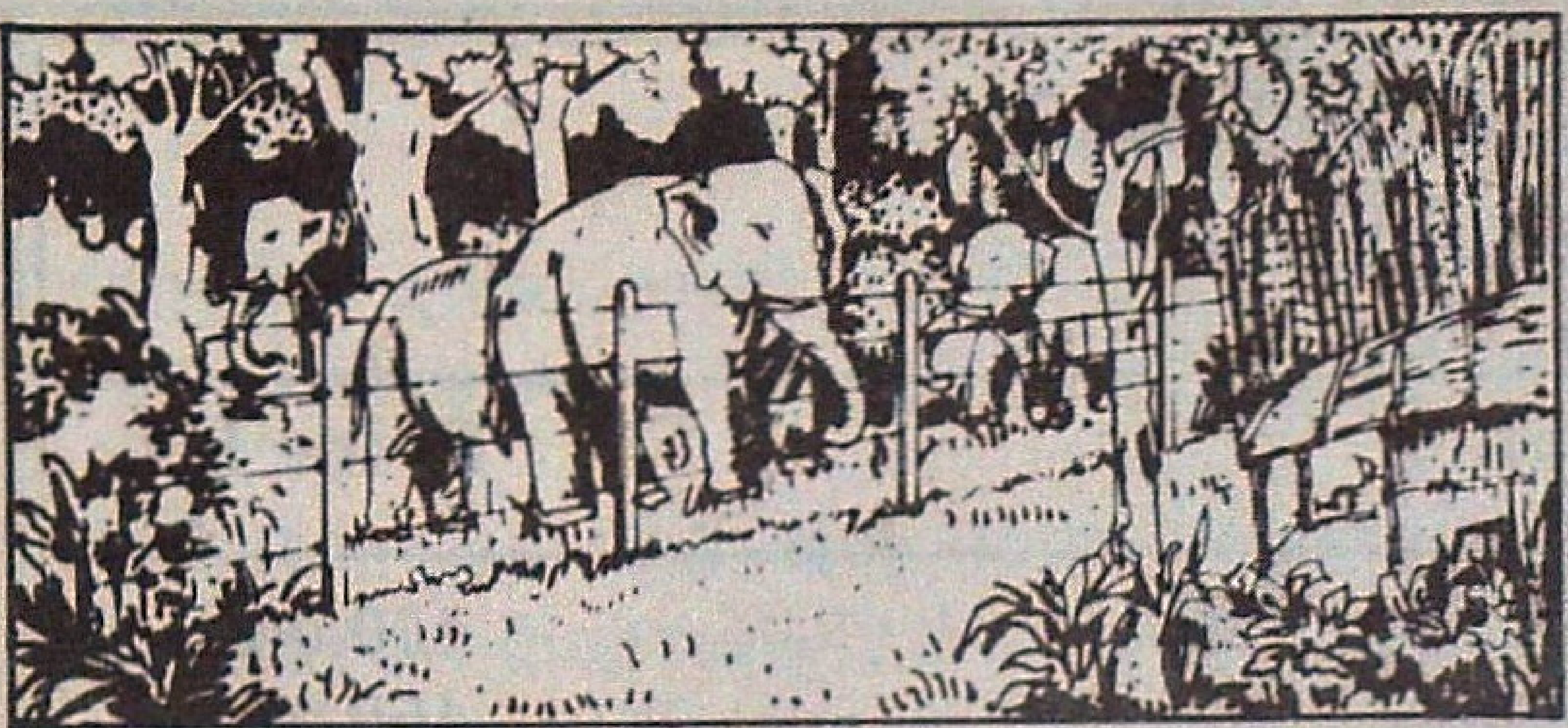

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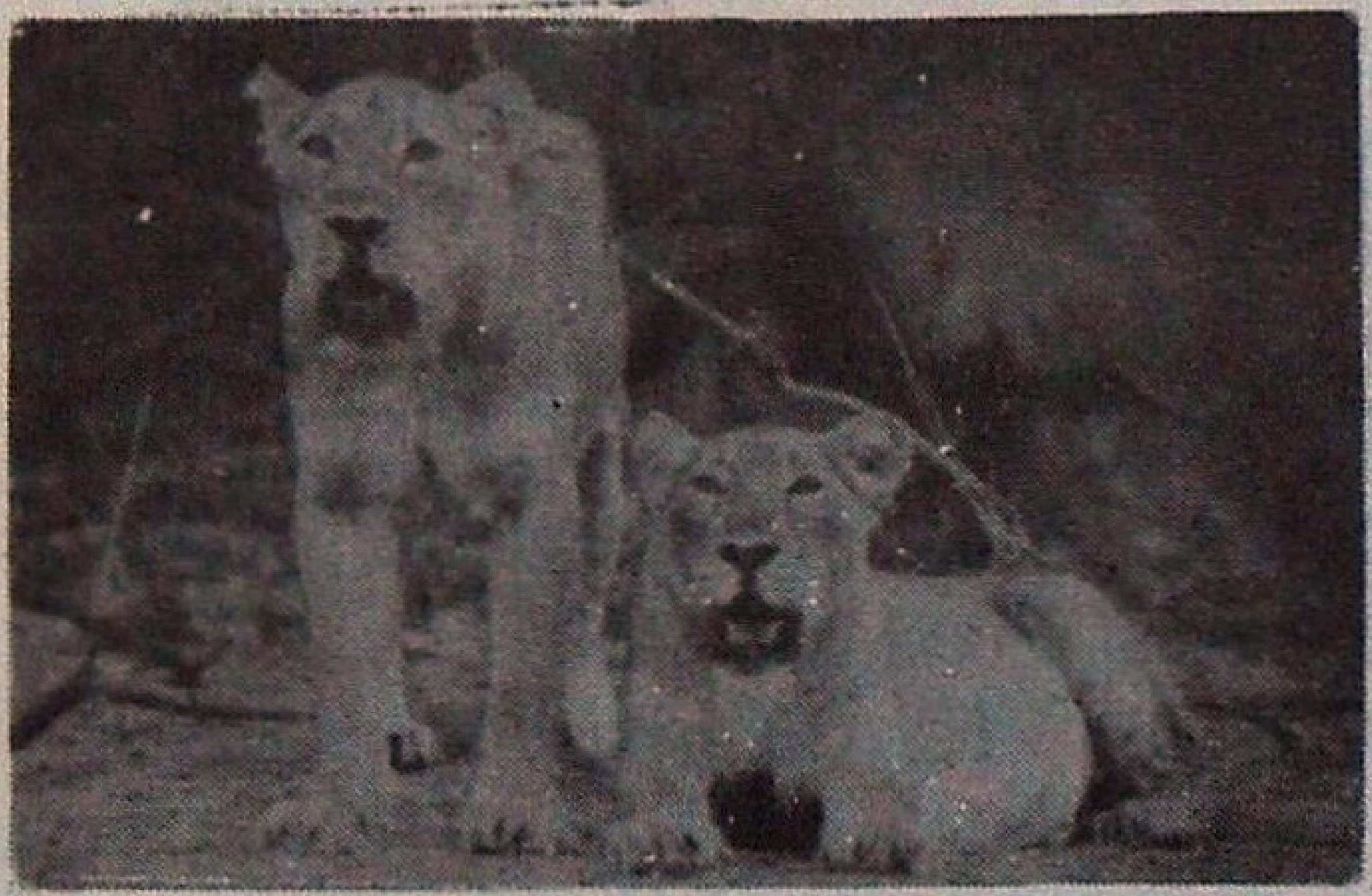

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Concerned About Forests? Contribute towards Forest Policy

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The Madhya Pradesh Government has acknowledged and accepted the Joint Forest Management system for protection and augmentation of forests. The State has constituted nearly 12,000 forest committees which are vigilantly guarding nearly 60,000 sq. kms of forests.

However, 40% of the State's forests are degraded because of the immense biotic pressure and `forest insensitive' development schemes.

For the protection, and enrichment of the sensitive and rich heritage that is forests, the State of M.P. now contemplates to formulate a forest policy with the help of forest dwellers. The execution of this policy is expected to usher in conservation and augmentation of the forest resource on one hand and sustainable economic and social development of forest dependent people, on the other. This policy would be the one which would enable the State to harvest the forest produce on sustainable basis and through which, the forest produce would be essentially processed and value added allowing the growth and prosperity of cottage industry. It would thus be a harbinger of maximum benefits to the people.

With a view to acquiring the best of ideas from the aware, enlightened and, concerned citizens the Madhya Pradesh Forest Department solicits views about the State Forest Policy and on the ways of implementing it. Your views/expressions are kindly invited at the following address :-

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Conservator of Forests (Policy Analysis Unit)
Office of the Principal Chief Conservator of Forests
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हिन्दी नाम	
स्थानिय नाम Local Name	
संस्कृत Sanskrit	
अंग्रेजी English	
बंगाली Bengali	
पंजाबी Punjabi	
तेलगु Telugu	
तमिल Tamil	
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कन्नड़ Kannada	
मलयालम Malayalam	
उड़िया Oriya	
असमी Assami	

↑ 11.5" ↓

13 भाषा नाम पत्रक

रोपित प्रजाति की बॉटनी–आयुर्वेद–कृषि–विद्यार्थियों, वनाधिकारियों, आयुर्वेदाचार्यों, उद्यानविज्ञों, कृषि–वैज्ञानिकों, पर्यावरणविदों एवं एतद् सम्बन्धित शोधार्थियों को प्रमुखता से पाए जाने वाले 108 प्रजातियों के वृक्षों की, लोहे की सफेद चद्दर पर आकर्षक रंगों में मुद्रित प्लेट पर स्थानीय नाम लिखवाने हेतु पर्याप्त खाली जगह छोड़ी गयी है, जिसे वृक्ष के तने पर या स्टेण्ड़ के साथ पौधे के गमले–थांवले–क्यारी पर लगवाकर परिसर की अनोखी पहचान बनाकर, आगन्तुकों को प्रजाति के 13 भाषाओं के नामों की जानकारी देते हुए परिसर की शोभा बढ़ा सकते हैं। उक्त प्लेट 4"X11.5" साइज़ में उपलब्ध होगी।

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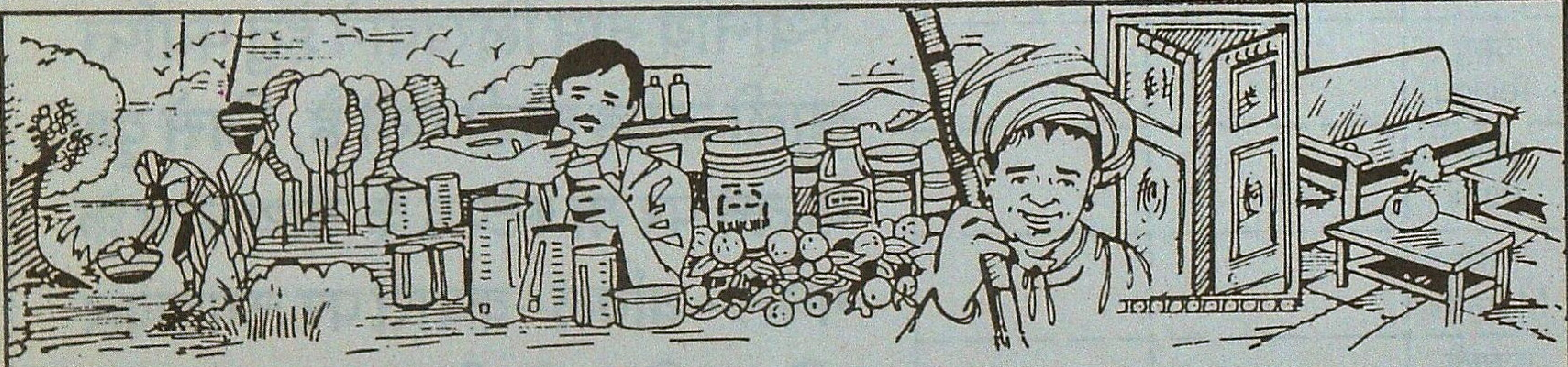

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For More Information Contact

Deputy Conservator of Forest
Nanda Devi National Park
Joshimath (Chamoli)
Ph : 22179

Joint Director
Nanda Devi Biosphere Reserve
Gopeshwar (Chamoli)
Ph : 52497

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C/F 128. वृक्ष जीवन के आधार हैं		
C/F 129. धरती के परिधान हैं वृक्ष		
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C/F 131. एक वृक्ष दश पुत्र समाना		
C/F 132. वन है तो मानव जीवन है		
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C/F 134. वृक्षों के रक्षक बनें, भक्षक नहीं		
C/F 135. औषधियों के आधार हैं वन		
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C/F 196. पर्यावरण को संरक्षण देना, धरती माँ का मान बढ़ाना		
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C/F 214. जन आन्दोलन इसे बनायें, अधिकाधिक सब वृक्ष लगायें		
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C/F 217. घणा रुखड़ा घणी हरियाली, घणी बरसात देशरी खुशहाली		
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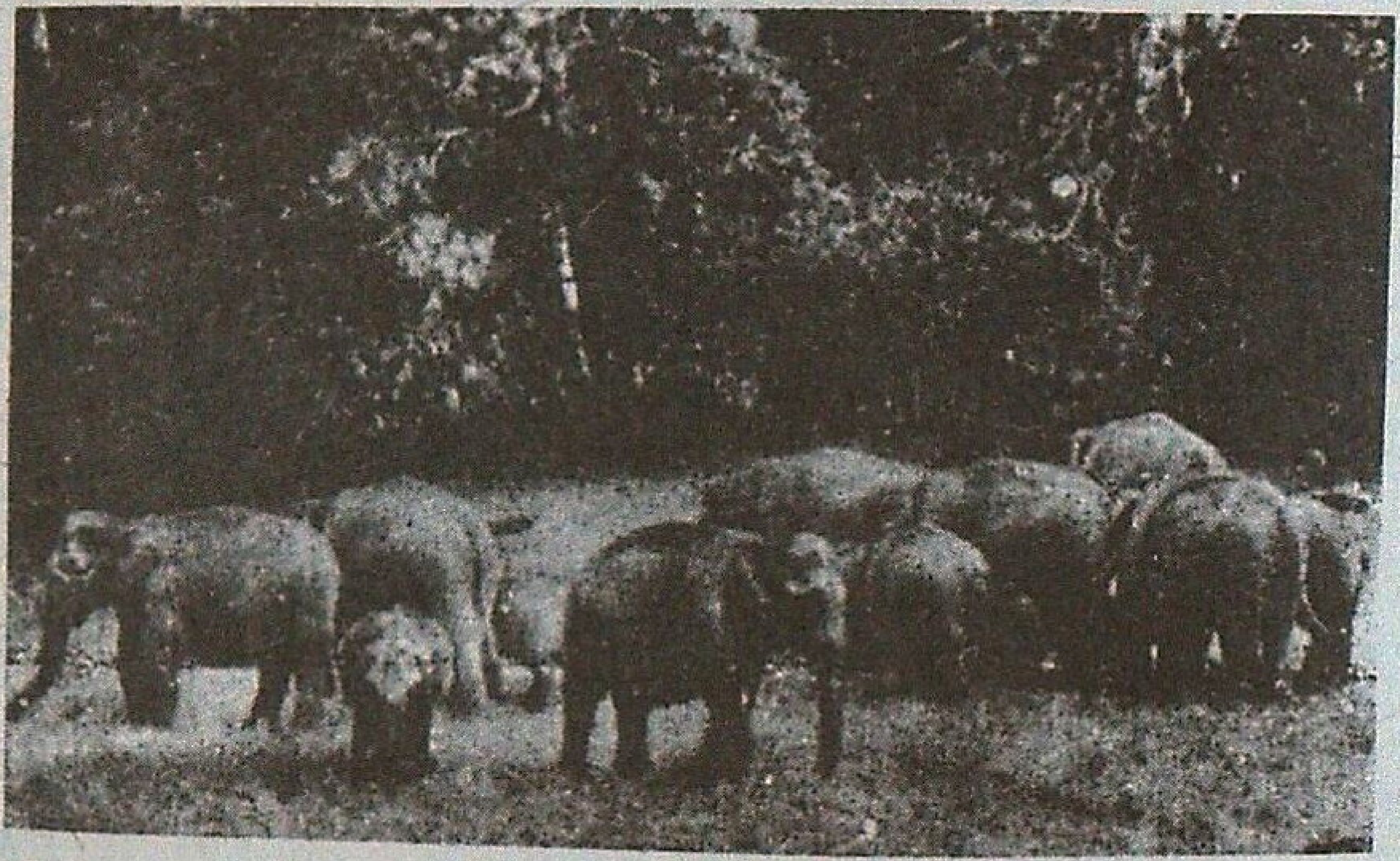

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For further particulars contact : WILD LIFE PRESERVATION OFFICER
Thekkady P.O., (Kerala) Telephone : KUMILY (04869)-22027

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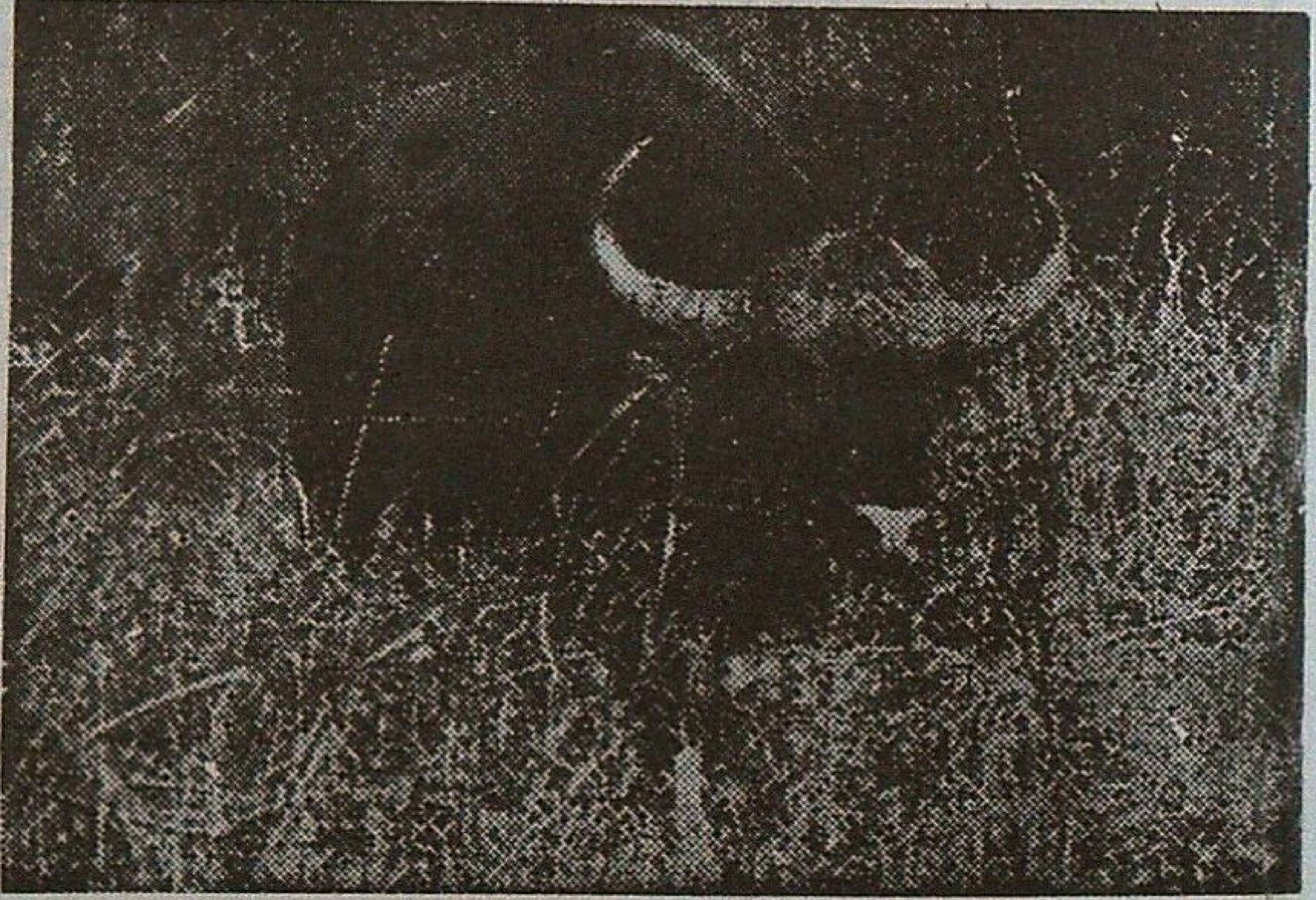

For further particulars write to :

THE FIELD DIRECTOR,
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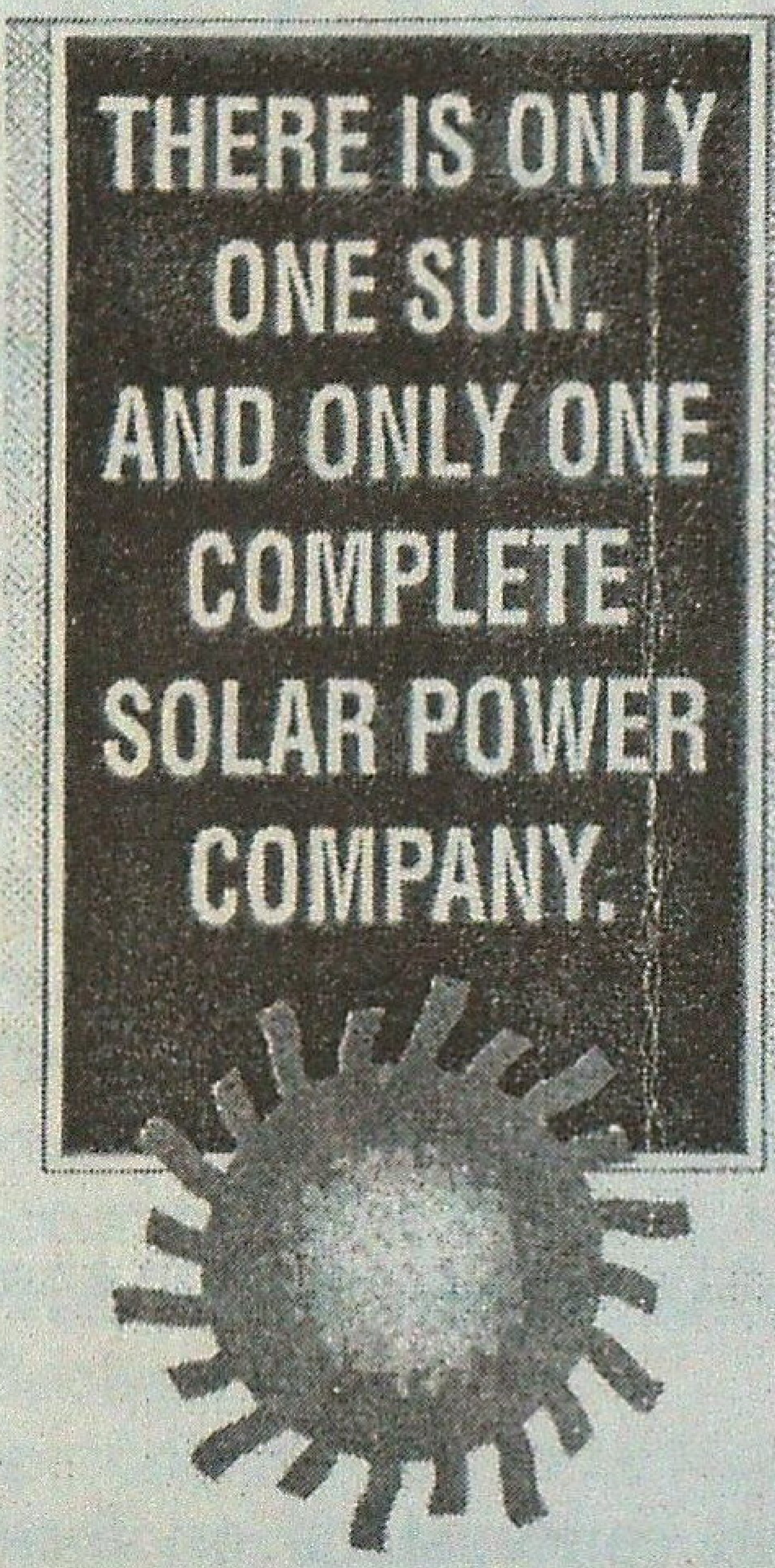
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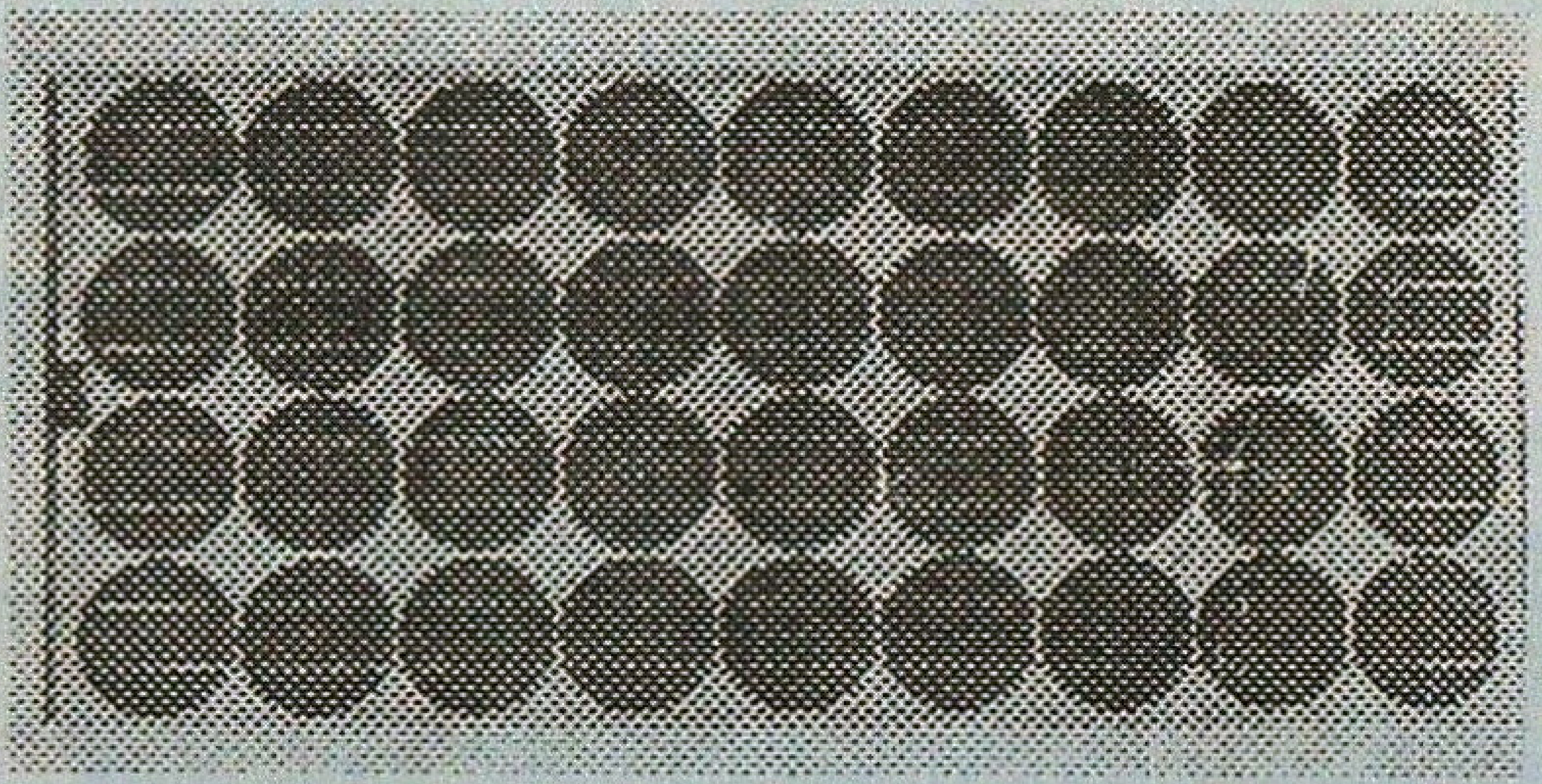

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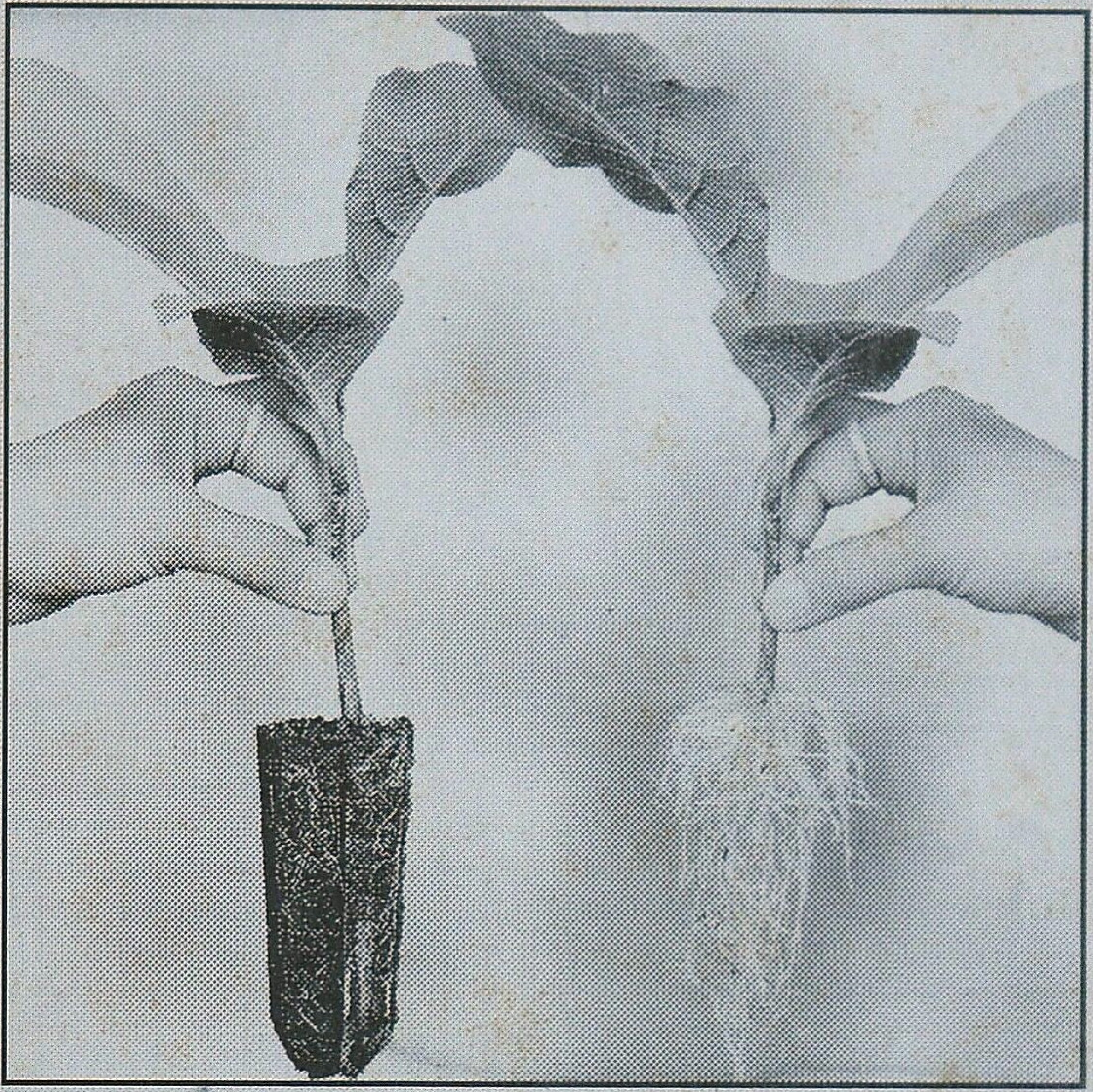

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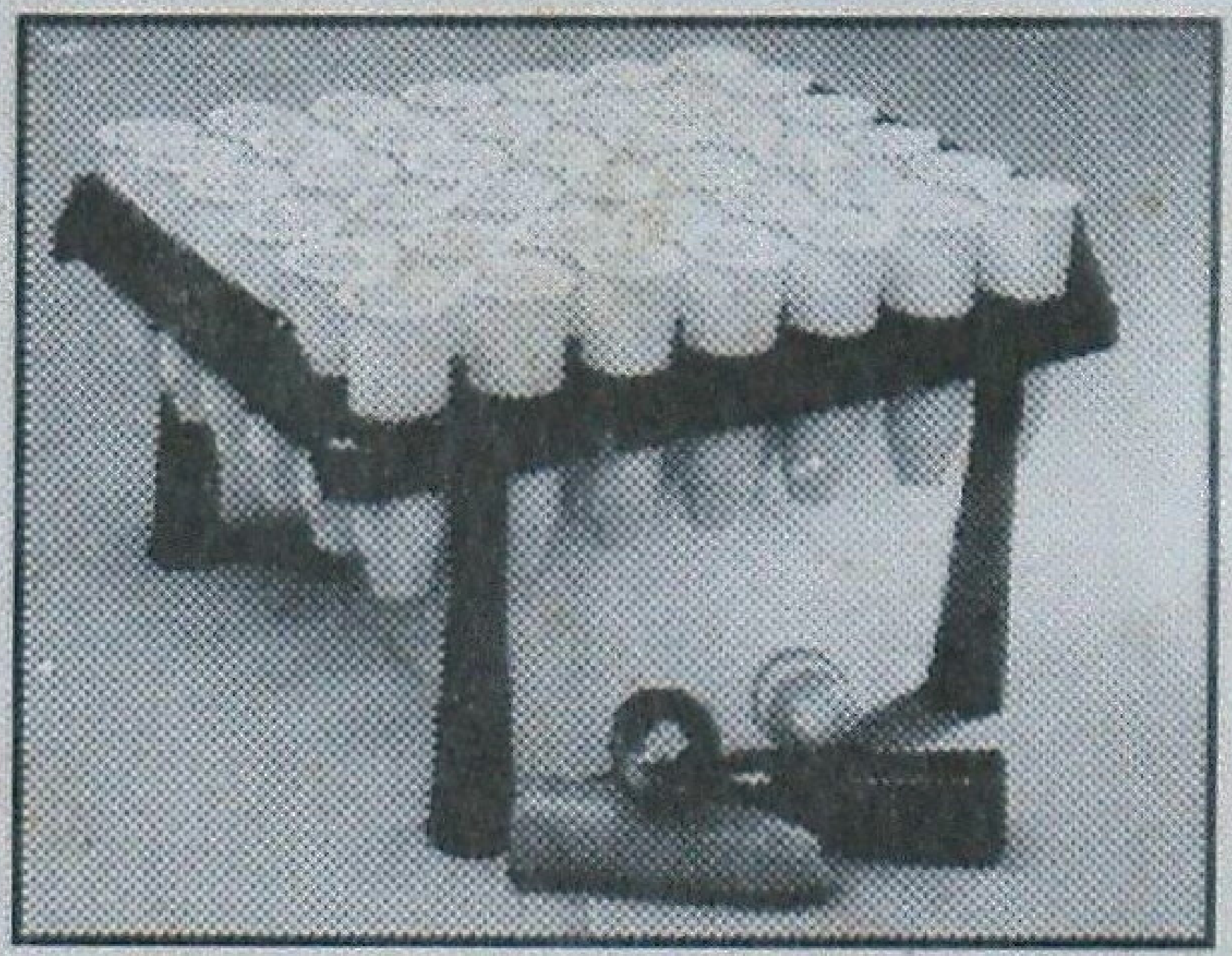

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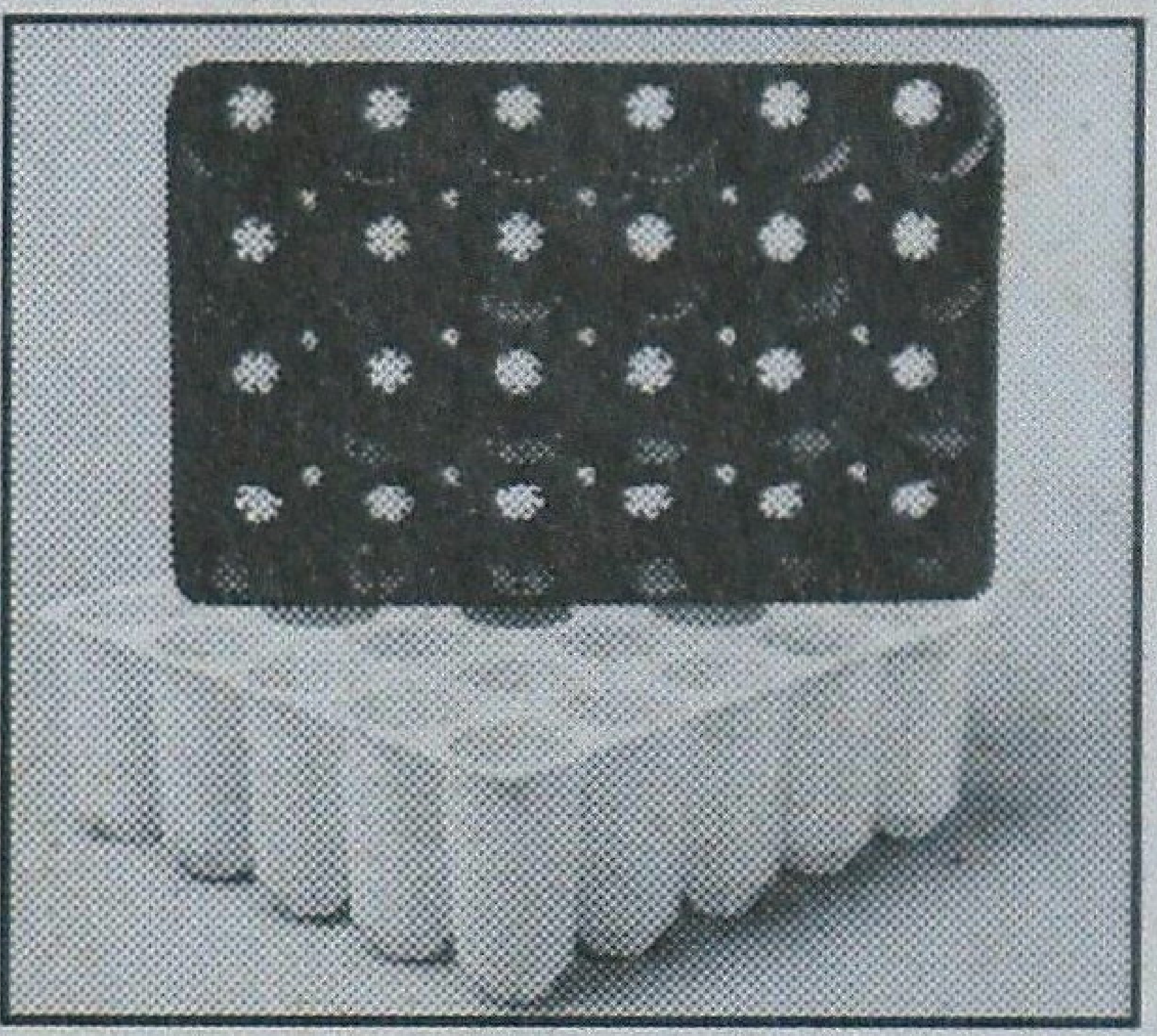

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